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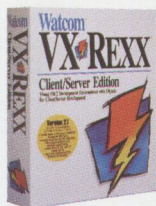
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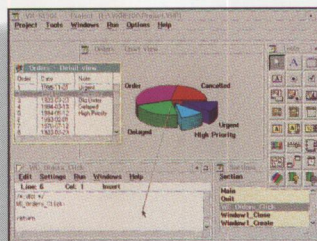
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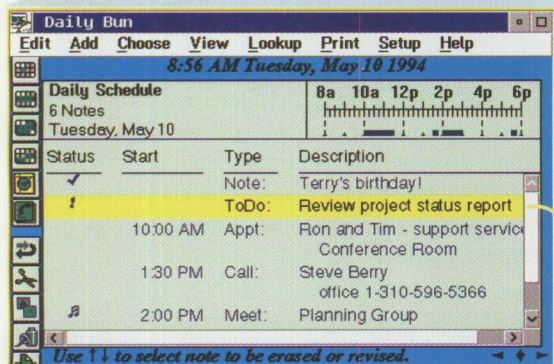


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Have You Been Warped?

OS/2 Warp. You've got to love the name! And the look!

Well, anyway, I do, because I've worked for IBM for 25 years and I like to see us put some fun into our products. Color! Games! Can you imagine? OS/2 Warp is not gray and dull. The advertising (yes, we have a smashing ad campaign going) is bright and fun. We've stepped outside the lines, and I, as well as a lot of other vintage IBMers, am loving it!

Don't get me wrong. OS/2 Warp is more than good looks and a great name. It's the fastest, most versatile personal computer operating system available today. It's a real lightweight in the memory department and a real heavyweight in the function department. It's backward-compatible. What in the world does backward-compatible mean? It means OS/2 Warp supports every application you're running on your computer today and will continue to do so.

Now, let's review a couple of the most significant points: "available today" and "backward-compatible." That means we're not making promises about what we might and might not deliver and when we might deliver it. OS/2 Warp has been available since early fourth quarter 1994 and has delivered on all its promises. Don't you wish every operating system developer could say that?

Unless you've been holed away in a monastery or cave for the last six months, you've heard and read a lot about the operating system war that is going on. Most of what you read and hear is *opinion*. What you'll read about OS/2 Warp in this issue of *Personal Systems* is *fact*. Our own technical expert, Edward Duhe', has been testing

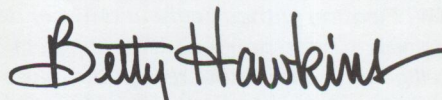
Warp since "Warp" was its code name instead of its real name. His thorough article is filled with the features and functions of OS/2—not hype, not opinion, "just the facts, Ma'am!" Read Edward's article and form your own opinions.

Internet Stuff

Internet. Information superhighway. Surfing the net. Whew! This must be big stuff because one of the first new features I hear most people mention when they talk about OS/2 Warp is its great new Internet access. I just finished editing an article about OS/2 Warp's Internet interface for another publication. The author is just a regular working person like you and me. I don't know about you, but there's a big difference in that author and me—he knows and loves the Internet; it remains a mystery to me. I'll confess, right now the only thing I use the Internet for is e-mail—to my faithful *Personal Systems* readers and my husband, who works two counties and several industry types away from me.

But I'm betting you'll soon be seeing *Personal Systems*, along with a host of other industry publications, on the Internet. So I'm going to sit down with my copy of Warp and learn to surf!

You can do it all and do it right now with OS/2 Warp. So fire your highway transportation unit (HTU) up to warp speed, beam down to your local software dispenser facility (LSDF), get Warp, and get warped!



Betty Hawkins, Editor





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So that you will get the most from all the information available, this Interchange also offers customized tracks on OS/2, AIX, OS/400, and MVS.

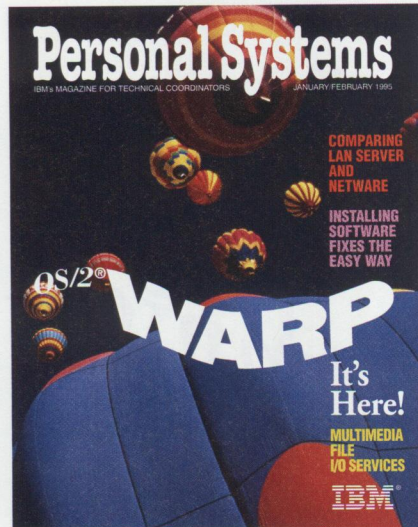
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ABOUT THE COVER

OS/2 Warp: this futuristic operating system is here today! Tried and tested by the masses! Backward-compatible with all your favorite applications! Easy to install! OS/2 Warp has it all—even a great name and an even greater look!

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IBM's best kept secret is now out in the open and available through the AISPO catalog: custom-developed software and internally developed applications not previously marketed outside of IBM. This article tells you how to get the catalog and describes some of its most popular products.

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On October 11, 1994, IBM introduced OS/2 Warp Version 3, the next evolution of its premier 32-bit operating system. As its name implies, OS/2 Warp is fast and full of state-of-the-art features. This article describes the new features of OS/2 Warp, including performance enhancements, installation enhancements, usability improvements, printing enhancements, new applications, and more. See what it's like to operate at warp speed!

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Help is on the way! LAN Server Specialist, a productivity aid included with LAN Server 4.0, provides a problem determination tool for LAN administrators. It gathers the problems, offers suggestions, and learns from each incident. This article describes the timely operations of this handy tool, which is already available to you if you have LAN Server 4.0.

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One-Stop Shopping

Now everything you need to get your local area network up and running, complete with application and performance monitoring service, is available in one package—IBM's Advanced Server for Workgroups. This article describes this product, its components, and the process behind its easy installation.

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Need a Fix?

The IBM Corrective Service Facility (CSF), formerly called FixTool, is a tool to distribute and install corrective service packages. This article discusses the service call and fix processes, describes CSF's features, and explains how to use CSF when installing ServicePak or fix.

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IBM LAN Server 4.0: New Features and Comparisons with NetWare

IBM LAN Server 4.0, announced in September 1994, has been a customer-driven product from the outset. Customers told IBM they wanted an easy-to-use, easy-to-install, and easy-to-administer network operating system. LAN Server 4.0 provides these things, and more, with its many new features and functions. This article covers the new features and enhancements in IBM LAN Server 4.0, and compares LAN Server 4.0 with Novell NetWare 4.02.

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IBM DCE Heterogeneous Enterprise Performance

This article presents some of the Distributed Computing Environment (DCE) performance characteristics observed in a moderately complex heterogeneous enterprise environment. The studies focus chiefly on the DCE topology performance, while noting the behavior of the DCE administrator, OS/2 Database Manager, and Network File System (NFS) services contending for the system resources.

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OS/2 for SMP and Windows NT Coexistence

This little solution describes how to install OS/2 for Symmetric Multiprocessing (SMP) and Microsoft Windows NT on a single, multiprocessor computer system.

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Technical Connection Personal Software Is the Answer!

By Tira Gillig

And the question is: "Where do I get immediate and comprehensive access to the latest in service and product support information?"

This article describes the support available through a subscription to IBM's Technical Connection Personal Software, details its implementation, and documents the enthusiastic response from early users of the product.

Technical Connection Personal Software CD-ROM is just the product you need for immediate and comprehensive access to the latest in service and product support information without accessing and downloading this information from bulletin boards. The Technical Connection is a CD-ROM loaded with answers to your technical support questions, information on the latest products, service updates, plus a bonus "OS/2 Collection" containing over 275 books on OS/2-related products.

It's like an electronic encyclopedia, only better! You can buy a one-time "set" of this valuable support tool, or you can subscribe to monthly or quarterly updates. Either way, you and your support team will have the answers you need at your fingertips.

Here's what some of the early Technical Connection users like about the CD-ROM:

- "It is a single source for many pieces of information I would have to spend much time and effort chasing down."
- "Everything is on one CD-ROM and readily available."
- "Online documentation and AskPSP are extremely helpful."
- "Lots of good information. I like it. A winner!!"
- "There's a paucity of in-depth technical information available—this [Technical Connection] gives a much needed boost in a concentrated, easily accessed format."

The Technical Connection, useful in both the OS/2 and DOS environments, is available in all geographical areas. You can access all the information (except AskPSP) in either operating system. AskPSP is an expert system tool and is an OS/2-only product. Language-translated versions of downloadable fixes are included.

OS/2 Implementation

The OS/2 installation process is quick and easy. You can accept the default paths for the installation, and, before you know it, you are ready to access Technical Connection's information! If you decide to change the defaults, just change the drive letter; the rest is done for you.

The installation executes in two parts: first, the required files are loaded onto the hard disk and the desktop icons are created; then, AskPSP is installed. Because updates need to point to several programs, you need to reboot your system after installation.

You need to consider the following:

- *Which partition to use*—Subsequent installations (updates) of Technical Connection will use the original partition you choose for the required files.
- *Whether to install AskPSP on the CD-ROM or hard disk*—Installing AskPSP on the hard disk provides quicker access to the information; access times for CD-ROMs are much slower than hard disks. However, if space is a consideration, accessing AskPSP from the CD-ROM drive is a viable option.

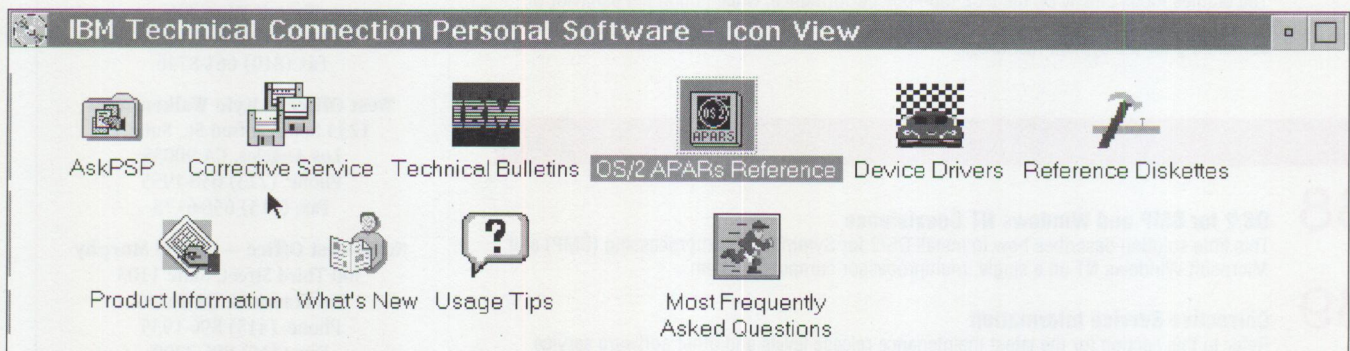


Figure 1. OS/2 Implementation: Database Icons

■ Which language version of *Corrective Service Diskettes (CSDs)* is needed—If you purchase Technical Connection's National Language version, you will receive several languages within each of the Europe/Middle East/Asia (EMEA) and Asia Pacific (AP) products. You may not need to install all of the languages. Following is a list of languages and their corresponding disks:

- Disk A—U.S. English, French Canadian
- Disk B—Not currently used; for expansion
- Disk C—Dutch, French, German, U.K. English
- Disk D—Italian, Portuguese, Spanish
- Disk E—Danish, Finnish, Norwegian, Swedish
- Disk F—Japanese, Korean, Traditional Chinese

The OS/2 implementation installs one icon labeled "IBM Technical Connection Personal Software" on your desktop. This icon then opens to another set of icons, which contains seven databases and three information areas. See Figure 1 for the icon representation.

DOS Implementation

It's also a simple matter to install the Technical Connection in DOS:

1. Switch to your CD-ROM drive and type **INSTALL**.
2. Choose the default drive you want to use for the required files.
3. Reboot after the installation completes.

After this quick and easy installation process, you can begin to access the Technical Connection files. With the recently enhanced mouse support, you can now use the mouse to make your selections. Figure 2 shows how you would find a reference diskette for a laptop computer.

From the DOS prompt, type **TC2**. The first of the three screens in Figure 2 shows the main Technical Connection screen in the DOS implementation. You are looking for a reference diskette in this example, so

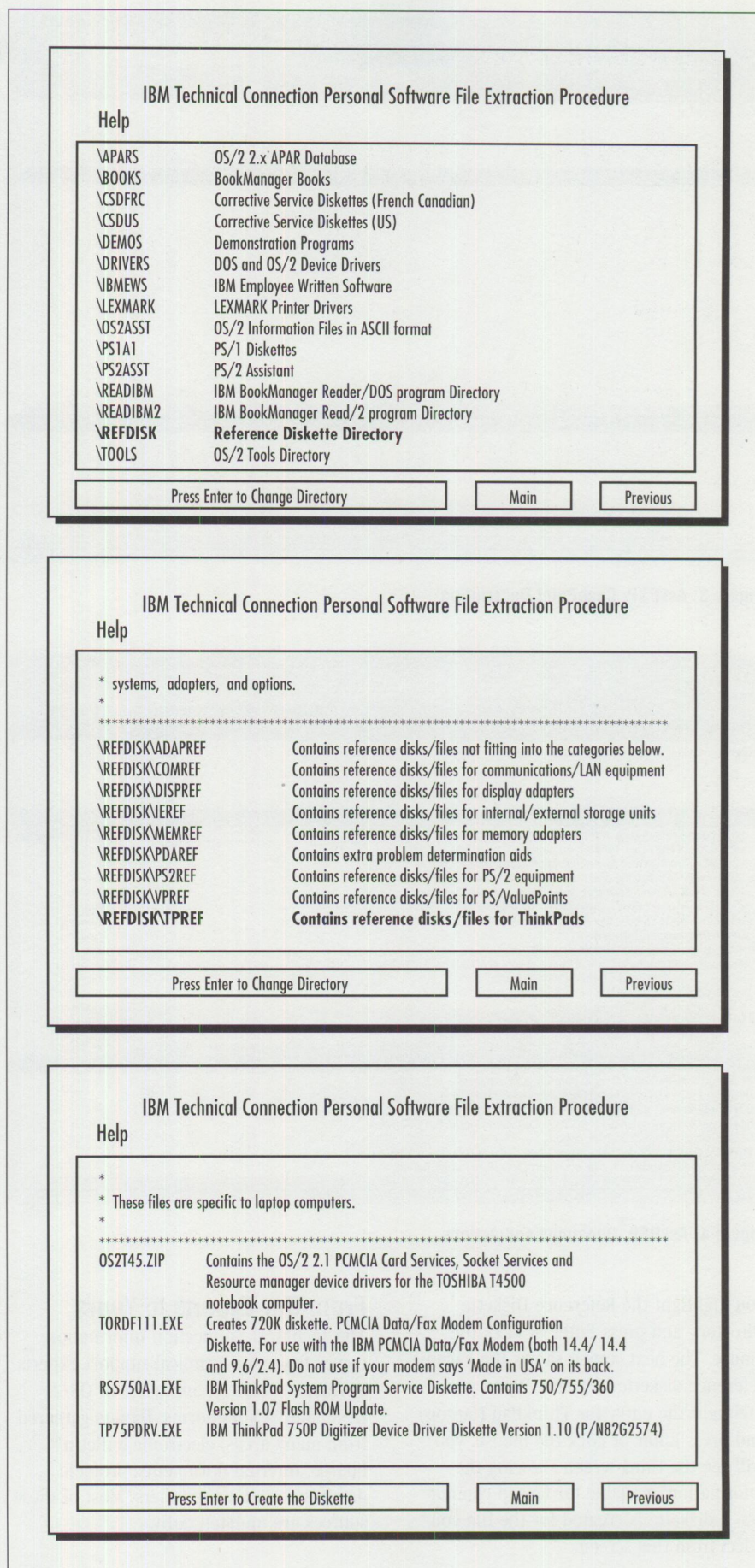


Figure 2. DOS Implementation: Creating a Reference Diskette

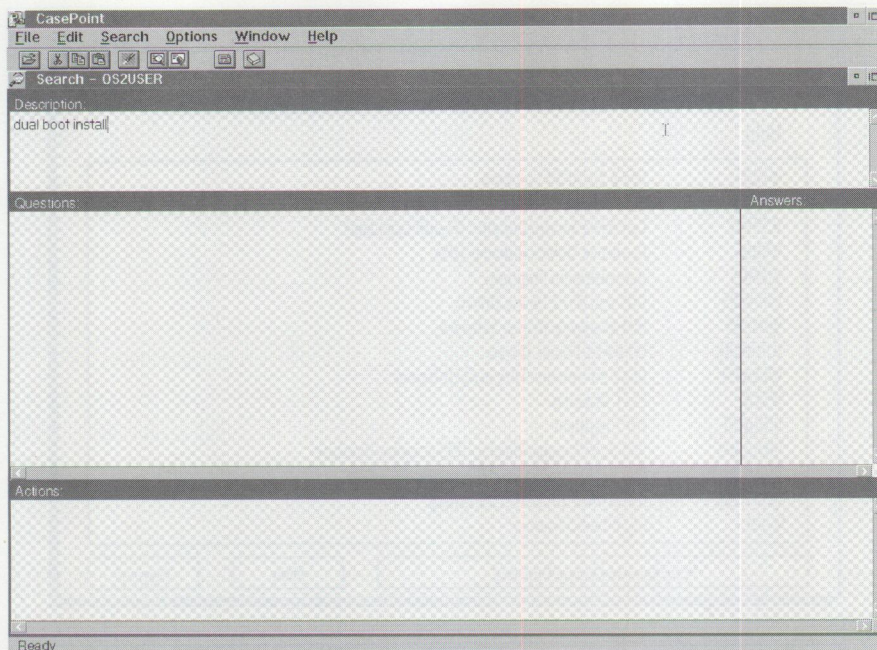


Figure 3. AskPSP: CasePoint Description

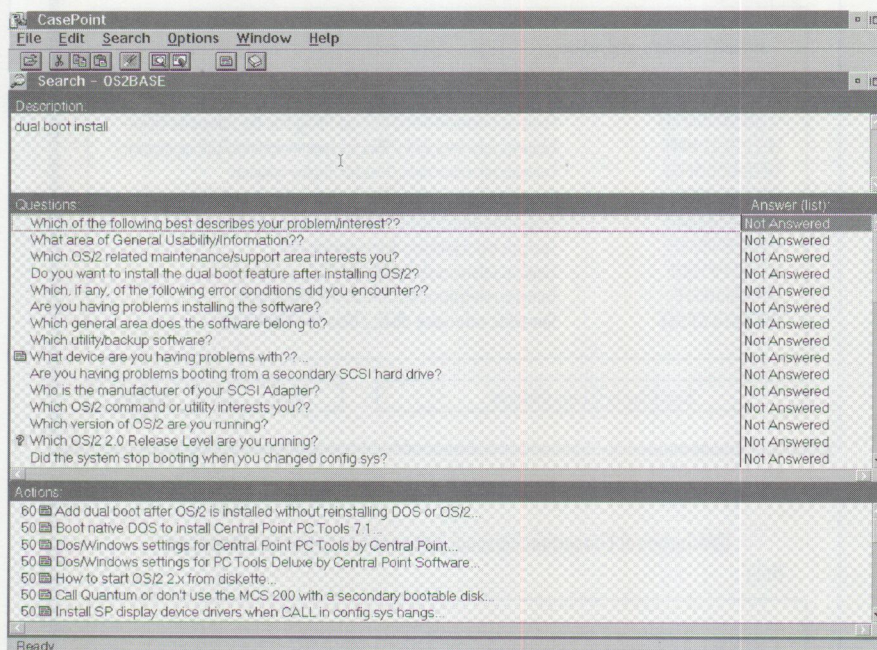


Figure 4. AskPSP: Questions and Actions

you highlight the Reference Diskette Directory and press Enter or click the mouse. The next screen shows the various reference diskette libraries. When you highlight the entry for ThinkPad (laptop) and press Enter or click the mouse, you will see the third screen showing the information available for laptop computers. A diskette is created for the file you select from this screen.

From Our Experts to Yours

The Technical Connection information comes from our technical support experts, developers, testers, and users of OS/2, DOS, and LAN platforms. Data is gathered from many areas: electronic bulletin boards, internal documents, problem databases, and many others. Most of these sources are updated daily.

The Technical Connection team adds the latest data to the CD-ROM monthly. Outdated material is removed as warranted.

Following are descriptions of the material that is available each month to enhance your role as a technical coordinator within your organization.

Information Areas

The Technical Connection provides you with three information areas:

- **What's New**—A quick snapshot of what files have been added, deleted, or changed on the current month's CD-ROM.
- **Usage Tips**—Hints for better usage of the CD-ROM—tips the Technical Connection team has found that will help you more easily access the information plus hints about the contents.
- **Most Frequently Asked Questions**—Answers to questions most frequently asked of IBM's various service organizations. Checking out this section may save you a call to IBM.

Databases

The Technical Connection contains seven databases of information: AskPSP, OS/2 Authorized Program Analysis Reports (APARs), Technical Bulletins, Corrective Service Diskettes, Reference and Diagnostic Diskettes, Device Drivers, and Product Information.

AskPSP

AskPSP is an expert system tool targeted for end users and help desk personnel—both novice and experienced users. Using AskPSP is easy. You choose the casebases (environments) you want to explore. These casebases are continually augmented as many of the cases are created directly from the calls coming into the support centers.

Today you have these options:

- OS/2 Initial User's Environment
- OS/2 Base Environment
- OS/2 LAN Environment
- Novell NetWare Environment

You can expect to find cases added each month as well as new product-related casebases added over time. All you need to know is the environment to which your

question relates and the parameters of your question. For example, if you want to find out about "dual boot" and how to implement it, you would enter "dual boot" in the Description area of the CasePoint screen (see Figure 3). AskPSP provides you with a set of questions to answer, as shown in Figure 4.

After answering the appropriate questions, the Actions section of the screen gives possible answers. Solutions with a rating of 80 or more will typically contain an appropriate answer to your search. If there is not a case for a particular problem, no answer will be shown.

OS/2 APARs

In this area, you will find the latest in closed APARs for the products covered on the Technical Connection CD-ROM. You can access the same information that IBM service personnel use to answer questions. Figure 5 lists the products for which APARs are available. You may select any, all, or a combination of products for your search. As an example, Figure 5 shows a search for three products.

Technical Bulletins

A wealth of knowledge is at your fingertips in both the OS/2 and PS/2 Assist areas in the Technical Bulletins section of the Technical Connection. In OS/2 Assist, you will find hints and tips on installation solutions created by the service providers, a guide on how to report problems, software written by IBM employees, Timothy S. Simples' "OS/2 Most Frequently Asked Questions," plus much more.

The IBM OS/2 Information section provides you with detailed technical information on performance, tuning, keyboard and pointing devices, hardware and PC devices, serial communications, and PenCentral information.

Other OS/2 Assist information includes installation, service and support processes, debug tools, and books and manuals on both OS/2 and DATABASE 2 OS/2 (DB2/2).

In PS/2 Assist, you'll find hardware-related information such as technical specifications, technical information, service information, and resources for PS/2s and PS/1s.

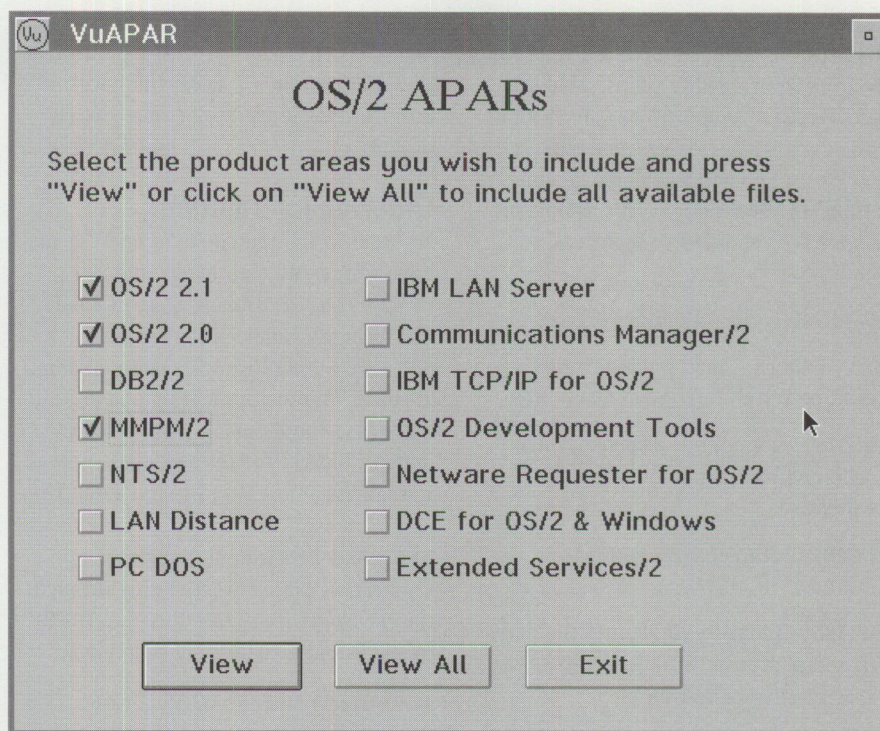


Figure 5. OS/2 APARs

Corrective Service Diskettes, Reference and Diagnostic Diskettes, and Device Drivers

These three databases contain compressed versions of the actual Corrective Service Diskettes, reference and diagnostic diskettes, and device drivers.

See Figure 6 for a representative sample of CSDs contained on a recent Technical Connection CD-ROM.

When you select the CSD you want, you will be prompted either to insert a diskette or to designate a partition on your hard drive. When you click on the desired CSD "hot spot," an expanded file will be written to the diskette or to your hard file.

The same process works for reference and diagnostic diskettes and device drivers—whether you want one diskette or a large number of diskettes—and the lists are just as extensive. A broad range of products is included and updated as new ones become available. Those elusive reference and diagnostic diskettes for your PS/2, PS/1, ValuePoint, ThinkPad, and various adapters and features are included. Just the right device driver for your printer, display, video card, or CD-ROM drive is also available. All can be downloaded with a few simple keystrokes.

OS/2 2.0 and later

OS/2 ES 1.0 Communications Manager

OS/2 ES 1.0 Database Manager

CICS OS/2 2.0

C Set/2

C Set ++

LAN Server 3.0

LAN Manager Utilities

Network Manager 1.0

NetView

Network Transport Services/2

System Performance Monitor/2 1.0 and 2.01

WorkFrame

DOS 5.0

PC/3270 3.0 and 3.1

Windows Connection

Advanced Program-to-Program Communication (APPC)

Figure 6. Corrective Service Diskettes

Product Information

This database contains the latest information from several publications, including *IBM Developer Support News*, Team OS/2 newsletters, PS newsletters, and DB2/2 newsletters. You will find some demonstration software along with a sample of software written by IBM employees, including:

- PS/2 L40 Battery Monitor
- Tiny Editor (a small [under 10 KB], easy, powerful, full-screen text editor)
- PMTREE (a graphical display of interaction with Presentation Manager windows)
- NetDUMP (three access control utilities)
- OS2PING (a utility to identify the paths in a local area network [LAN] to a specific adapter address)

Summary

All in all, these seven databases offer a significant amount of easily accessible information and data right on your desktop, without access charges for down-

loading information from a bulletin board. When combined with the information areas on the CD-ROM, you have everything you need to be immediately productive.

Ordering Information

To order in the United States and Canada, have your credit card handy and call (800) 992-4777. In the U.S. and Canada, the Technical Connection Personal Software CD-ROM is available in an annual subscription with monthly updates for \$299 (\$429 in Canada), with quarterly updates for \$119 (\$169 in Canada), or as a single issue for \$59 (\$85 in Canada).

In the Asia Pacific area, Technical Connection can be ordered only through the Developer Assistance Program (DAP) in single and quarterly subscriptions:

- Australian DAP—+61-2-354-7684
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- Korean DAP—+822-781-7770 or +822-781-7777
- Japan DAP (fax only)—+81-3-3279-8231

In Europe/Middle East/Asia areas, single purchases can be ordered through retail channels. Subscription orders can be purchased only through ISMS Direct Services.

As an added bonus, the "OS/2 Collection," containing over 275 books related to various OS/2-related products, is included with each purchase.

Note: The Technical Connection Personal Software product is a dynamic product, updated and improved every month. Screen representations in this article may not identically match those in your product. In addition, prices are subject to change without notice.

Thanks

The Technical Connection team thanks you for taking the time to read about our product. The core development team is located in Boca Raton, Florida; Austin, Texas; and Vancouver, Canada. We welcome comments on the product through the Customer Feedback card included with the product or through our Internet ID: tcps-cd@vnet.ibm.com.

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Tira Gillig is an advisory programmer in Personal Software Products Service and Support in Boca Raton, Florida. She managed the introduction of the Technical

Connection into the marketplace and currently manages the day-to-day activities of the Technical Connection team. Tira is also responsible for service information strategy, creativity, re-engineering, and patent coordination within software services.

She has worked in software during her career in development, process, education, and service in first- and second-line management, staff, and development roles. Tira recently received an MPS degree in Industrial Counseling from New York Institute of Technology. She also holds an MBA in International Business and a BA in Spanish from Indiana University.

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Point of View

Visualizer, DB2/2, and You— An End-User's Perspective

By Bob Angell

In this first of a series of articles, Bob Angell, principal with Applied Information and Management Systems, describes the features of Visualizer and details his experiences with its installation. Future articles will explore some of the functions available in this database product.

The word *Visual* has been part of IBM's naming strategy for several of its recently released products. Visualizer, not to be confused with VisualGen or VisualAge, is a graphical user interface (GUI)-based database product that allows you to interface with and use data generated from PC-based workstations as well as from midrange systems such as AS/400s.

Because data comes from different sources (relational and non-relational distributed databases, flat files, etc.) and can be presented in many different ways, Visualizer was developed to recognize and take advantage of these environments.

Visualizer's GUI gives even a novice the power to become an expert data analyst with a minimal learning curve. In this article, however, I will assume you are familiar with database design and development and have procedural programming skills but that you have limited structured query language (SQL) skills. I will give you an end-user's perspective of how easy or difficult it is to install Visualizer and use it for a real project.

Background

Our firm, Applied Information and Management Systems (AIMS), received a copy of the Visualizer family of programs a few months ago. AIMS decided that DATABASE 2 OS/2 (DB2/2) and Visualizer might be the right combination to more tightly integrate one of our in-house database applications with its OS/2 and LAN Server environments. We originally

wrote this database application to provide physicians and residents with real-time patient demographic, clinical, and research information. This application allows physicians and computers to do what they each do best—practice medicine and massage information respectively.

AIMS had evaluated other GUI development tools, from C++ and VisualAge to the various visual REXX offerings. These other products either were too much work (C++ and VisualAge) or were just not beefy enough (visual REXX tools). Visualizer provides many of the tools (queries, charts, procedures, development environments, etc.) needed to get a project up and running almost immediately.

Our next development phase will be to make the entire program more of a client/server application using DB2/2 as the database engine and the Visualizer family of GUI applications to gather, process, manipulate, and present the data. We'll talk about this in future articles.

Getting Started

When you start to use a new software package, you usually experience a learning curve before you understand and master it. This learning curve can take minutes, hours, days, or even months. The manuals that ship with the product usually minimize this learning curve by documenting most of the fundamental operations.

Visualizer comes with two manuals: *Installing and Supporting, Visualizer*

Query for OS/2 and *Using, Visualizer Query for OS/2. Installing and Supporting* tells you how to install the product, obtain appropriate data connections, and support the product. There is also a discussion on using Visualizer's diagnostic aids and how to report problems back to IBM.

The installation process did not go as smoothly as I expected; however, it was nothing that couldn't be remedied by knowing a little about OS/2. I selected and tested only the DB2/2 data connection out of a variety of different options (DB2/6000, MVS, AS/400, Advanced Program-to-Program Communication [APPC] processes, etc.). As our project matures, we will likely use more of these data connections.

Using, Visualizer Query for OS/2 gives step-by-step instructions on using the program. The first section of the manual deals with the basics of Query for OS/2, showing how to use the Visualizer templates and online help. This section also shows how the Visualizer family of products (Charts, Development, Plans, Procedures, Statistics, and Ultimeidia Query for OS/2) fit together. The second section of the manual shows how to use and create SQL tables and views as well as how to combine, retrieve, and manipulate the table and view data using queries. Once you master the art of producing queries, the manual provides information on analyzing and presenting the data using Visualizer's report features.

Following the step-by-step process outlined in the manual, I was able to use the product fairly efficiently within a matter of hours. It seemed that without any other Visualizer module, interaction with the data was almost complete; however, without the ability to chart the data, use the

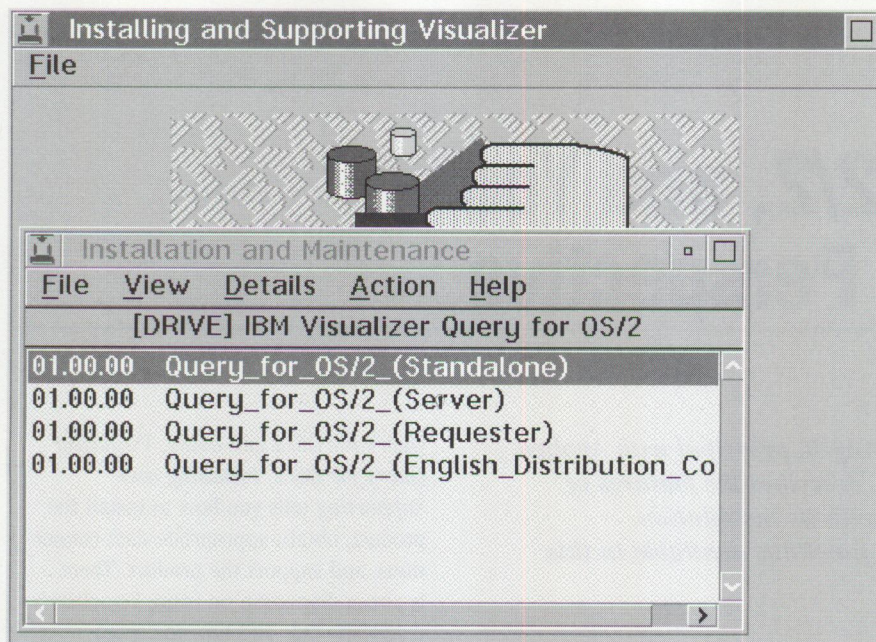


Figure 1. Visualizer Installation Screen

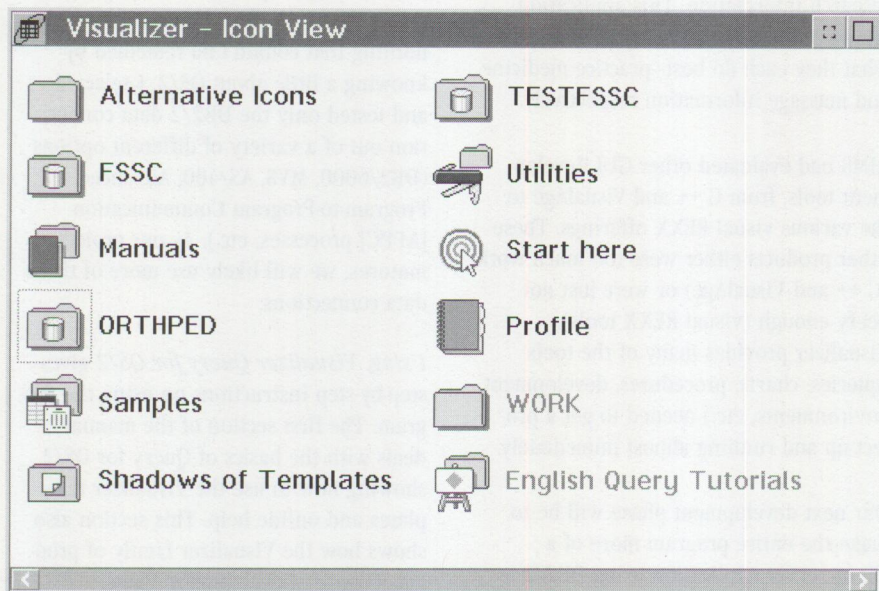


Figure 2. Visualizer Desktop Folder

statistical features, or take advantage of the Plans, Procedures, and Development code, the entire data interaction process could be painful.

As with most product documentation, the Visualizer Query manuals are incomplete when you want to understand the less popular and non-intuitive features (sometimes the real meat and potatoes of what you need to accomplish). For example, AIMS has data from many dBASE III+ and Paradox files that were a real pain to convert to either a Visualizer or a DB2/2

table format. In fact, if the files had been a bit larger, we would have had to convert them to the new formats in pieces.

Note: At this point, it is still not clear to me what, if any, advantage a Visualizer table format has over a basic SQL structured table. The one compelling reason to use SQL structured tables that quickly comes to my mind is that they are portable across many platforms. This is, for most users, an attractive alternative. The Visualizer development team tells me they are publishing a manual to help

users decide which table format is appropriate for which task.

I searched the documentation for how I could translate one table to another and finally figured it out by "doing" and "playing." This may just be a Visualizer weakness, but it does reduce the development efficiency Visualizer is supposed to provide. Overall, I found that most functions are intuitive to use. In fact, most of the time, I did not have to read the documentation.

Install Process Revisited

After accidentally deleting the Visualizer code from my workstation, I had to re-install it. I mentioned above that the initial installation went fairly smoothly; however, during the reinstallation, Visualizer's installation programs did not work as well.

The installation program provides the options shown in Figure 1. This is a standard format for installing all the Visualizer family of products. Visualizer can be installed as a stand-alone or as a server application. The latter can be very useful if you are accessing a database on a network or larger system (AS/400, RISC System/6000, etc.). After selecting Action on the menu to install the product, you then have the option to install all, part, or just a single piece of the program.

I found the recurring installation problem when Visualizer has transferred approximately three-fourths of the first diskette. A pop-up message appears indicating that Visualizer has been detected on the hard file and installation can't continue. Another dialogue box appears and asks whether I would like to delete the partial installation. After answering "yes" to the last question, all files are deleted and the program takes me back to the screen in Figure 1. Then, without exiting the program and answering the preliminary questions, the program installs without a hitch.

This happened on all of the Visualizer products as each one was reinstalled. I normally do not let minor problems like this bother me, but it became annoying when they consistently occurred.

Is There Life After Installation?

After the installation is complete, a Visualizer folder is created on the OS/2

desktop. A typical folder looks like the one in Figure 2; however, there are several folders shown that do not come standard with the program: TESTFSSC, ORTHPED and FSSC. These are all DB2/2 SQL databases that were already on my system. If Visualizer is installed with access to local, network, and mainframe databases, they would all be represented in the folder that is created.

The *Alternative Icons* folder provides different icons for different database situations. The *Manuals* folder contains very good online documentation. The *Samples* folder contains all of the documented data in the manuals, along with working code so you can see exactly what is happening and get a good feel for how a specific process occurs. As a true OS/2 application, a *Shadows of Templates* folder allows you to "tear" off a template when working with a database. The *Utilities* folder provides the ability to install other software features or bind Visualizer to an existing database. The *Start here* and *English Query Tutorials* folders provide tutorials, and the *Profile* folder is where all Visualizer features are globally set. Visualizer suggests that all database work is installed in a folder within the *WORK* folder to keep the working environment clear and clutter-free. However, when altering your OS/2 desktop, do what feels the most comfortable to you.

Now that you have successfully installed Visualizer, you'll want to know more about its functions. In future issues of *Personal Systems*, I'll review these features with you.



Bob Angell is a principal with Applied Information and Management Systems (AIMS) in Salt Lake City, Utah. A management consulting firm, AIMS specializes in manage-

ment information systems integration, OS/2 development and integration, total quality improvement engineering, and other related services. Bob specializes in multiplatform data integration, database design and development, simulation and modeling of complex environments (neural networks), and OS/2 software development. Bob can be reached through the Internet at bangel1@cs.utah.edu.

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Insiders' Software Unveiled

By Lia Wilson

Here's something you'll want to see! IBM's AISPO catalog, your inside track to tools and productivity aids, is a phone call away. This catalog concisely lists over 50 selected IBM software applications (developed either internally or with customers) that are now available to you.

These tools and productivity aids come from a variety of sources, including IBM research labs, IBM industry groups, and IBM marketing divisions and are available for all IBM platforms. User-tested and proven successful, these products can benefit you by letting you take advantage of products designed for others with similar business requirements. Although AISPO products come with no warranty or support, you can contact your local IBM branch office and contract for technical support or other services such as education, customization, and installation for many of the products.

Humble Beginnings

Although AISPO products have been around for years, customers didn't have direct access to them until very recently. Originally, if a customer wanted one of these products, IBM would write a specific services contract. Wanting to make it easy for customers to purchase this software directly, IBM made these products available through the AISPO products catalog.

Ever evolving, the catalog that began as an online file emerged in its current printed format for the first time in May 1994. To keep the catalog as current as possible, IBM plans to update it frequently—at least three or four times a year.

The catalog not only includes descriptions of each AISPO product, but also includes information on systems and programming environments, ordering (such as the length of the test period), the license agreement, price, and product information sheet numbers. Use the product information sheet numbers to request more

How Can You Receive This Catalog?

To receive your free copy of the AISPO products catalog, call (800) IBM-6676, ext. 650.

If you have access to TalkLink (through IBMLink), you can view an online version. (Several AISPO product forums also exist where you can ask questions regarding AISPO products.)

How Can You Order AISPO Products?

You can order AISPO products directly from IBM by calling (800) IBM-CALL. Please specify the product number when ordering. We've listed the products discussed in this article below along with their product numbers.

Product	Product Number
LAN Automated Distribution/2 (LAD/2)	5764-031
InterfloX Release 2	5764-053
IBM PlayAtWill	5764-085
IntelliAgent	5764-087
AGSS (A Graphical Statistical System)	
PC and PS/2 Version (DOS)	5764-009
Workstation Version (OS/2, AIX/6000, Sun Solaris)	5764-092
Distributed Database Query Services/2 (DDQS/2)	5764-056
Current ISO 9000 Audit Toolkit	5764-068

detailed information about specific products from the IBM FAX service. Simply call (800) IBM-4FAX and have the product information faxed directly to your fax machine.

Most products in the AISPO catalog come with a two-month test period. You can try the software and return it, no questions asked, if you are not completely satisfied.

Not So Humble Offerings

Catalog offerings span a range of user needs and are categorized by the following platforms:

- Personal Computer
- Multiple Platform
- RISC System/6000
- AS/400

■ VM and MVS

■ Retail Industry (4680/4690 and related platforms)

When asked which of the products designed for the personal computer platform are the most popular, Scott Ahlers, Manager of AISPO products, responded that LAD/2 and InterfloX Release 2 are especially in demand.

LAD/2 (LAN Automated

Distribution/2) enables you to quickly and efficiently configure and install operating systems and applications on a local area network (LAN). By automating many of the manual tasks involved in installations across networks, LAD/2 saves you time and insulates you from the complex remote installation procedures through an easy-to-use Presentation Manager (PM) interface.

LAD/2 automatically:

- Generates a response file, a LAN CID utility (LCU) command file, and NetView Distribution Manager/2 (NVDM/2) change files.
- Partitions and formats client hard drives.
- Generates LDU MAP and PKG files.
- Creates OS/2 and DOS boot diskettes.

LAD/2 supports the configuration and installation of the following configuration/installation/distribution (CID)-enabled products:

- OS/2 2.0 or OS/2 2.1
- Network Transport Services/2 (NTS/2 - LAN adapter and protocol support [LAPS])
- Communication Manager/2 and Extended Services
- DATABASE 2 OS/2 and Extended Services
- LAN Server 3.0 Advanced
- NetView Distribution Manager/2
- OS/2 ServicePak

You can obtain technical support, installation, and customization services for this product from IBM for a fee. For more information about LAD/2, call (800) IBM-4FAX and request product information sheet number 2790.

InterfloX Release 2 is a programmer's toolkit providing a REXX application programming interface (API) to Lotus Notes. This robust, easy-to-use toolkit enables an OS/2 REXX program to access, modify, create, and delete Lotus Notes databases and documents. Use it to connect Lotus Notes to host systems and other databases such as DB2/2.

You'll discover how simple it is to program with InterfloX through the following features:

- InterfloX uses 60+ high-level functions instead of 300+ C functions.
- Ninety percent of programming needs are found in seven of the functions.
- Its enhanced error checking and data validation provides improvement

over errors common with C-API programming.

You can obtain product support for InterfloX as an optional fee service. For more information about InterfloX, call (800) IBM-4FAX and request product information sheet number 2785.

According to Ahlers, several recently released AISPO offerings expected to do well include:

- IBM PlayAtWill
- IntelliAgent
- AGSS PC and PS/2 Version (DOS) and Workstation Version (OS/2, AIX/6000, Sun Solaris)
- Distributed Database Query Services/2 (DDQS/2)
- Current ISO 9000 Audit Toolkit

IBM PlayAtWill is an advanced Personal Computer Memory Card International Association (PCMCIA) software utility for PC cards that allows you to "plug and play" by identifying the type of PCMCIA card you've plugged in.

Using its auto-Configurator function, PlayAtWill automatically sets the input/output (I/O) address and interrupt level to make the card ready for immediate use. It also displays information on the type of PC card you've plugged in, along with its status and that of the PC slot. This program provides you with the ability to register an application that is supported on OS/2 and Windows platforms, directing PlayAtWill to automatically run that application when that specific PC card is plugged in.

For more information about IBM PlayAtWill, call (800) IBM-4FAX and request product information sheet number 1008.

IntelliAgent is an electronic tool to help you manage your daily work, including automatically handling routine tasks. It works for you 24 hours a day, 7 days a week.

By creating specific instructions (you need no programming knowledge), you tell IntelliAgent what you want done, when you want it, and how to perform it. Some of the tasks IntelliAgent can perform for you include:

- File activities such as monitoring a file for changes, then starting a program to update it and distribute it to others, send messages or reports, or print files.
- Mail activities such as checking and sorting your mail, then filing or discarding it, and/or forwarding it. You can even use incoming mail items to trigger other things like starting a program, backing up a file, etc.
- Time-driven activities such as sending a message or starting a program on specified days of the week or month at a given time.

IntelliAgent comes with online information and a tutorial to help you create the graphic instructions that will put your electronic assistant to work!

For more information about IntelliAgent, call (800) IBM-4FAX and request product information sheet 1372.

AGSS (A Graphical Statistical System) PC and PS/2 Version (DOS) and Workstation Version (OS/2, AIX/6000, Sun Solaris) This state-of-the-art interactive system provides an easy-to-use environment for scientific/engineering graphics, applied statistics, and exploratory data analysis. Although built upon APL, you need only a rudimentary knowledge of APL to use it effectively as a high-level, menu-driven system. With moderate knowledge of APL, the system becomes uniquely extendable and customizable.

Some features include:

- An easy-to-use menu-driven system with a complete set of context sensitive helps.
- A graphics component containing a wide assortment of two and three dimensional color graphics.
- Data analysis and statistics components that combine extensive graphical output with formal statistical model fitting and testing procedures.
- A statistics component that includes linear and nonlinear regression, reliability analysis, accelerated life testing, time series analysis, experiment design, and quality control.
- Extensive work management utilities.

AGSS is also available for the IBM S/370 and S/390 under VM platforms.

For more information on AGSS, call (800) IBM-4FAX and request product information sheet 2791.

Distributed Database Query

Services/2 (DDQS/2) is an interactive query development application. Running on OS/2, this Presentation Manager application provides access to IBM's local and remote relational databases.

Features include:

- The ability to accommodate users with varying levels of structured query language (SQL) proficiency.
- A reporting environment for managing data, including mechanisms for exporting data for use in other PC applications such as spreadsheets.

- A "walk up and use" design allowing intuitive operation.

For more information on Distributed Database Query Services/2, call (800) IBM-4FAX and request product information sheet number 2782.

Current ISO 9000 Audit Toolkit is a DOS/Windows-based personal information manager (PIM) that allows business professionals to manage multiple assignments, projects, and people on a daily, weekly, and monthly basis. This program combines the power of the IBM Current Version 1 (plus enhancements) with a set of special forms and other information prepared to serve the needs of the ISO 9000 auditor.

ISO 9000 auditors will find themselves more productive with the "Smart Forms" included with this program. This set of

special forms "knows" which fields require text, numeric data, dates, dollar values, etc. Multiple choice and linked fields aid in data selection. Multiple choice fields display all options; linked fields display all options when the user taps on the field; clicking on a choice fills in the field.

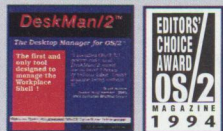
For more information about Current ISO 9000 Audit Toolkit, call (800) IBM-4FAX and request product information sheet number 2784.



Lia Wilson, editorial assistant for *Personal Systems* magazine, joined IBM five years ago. She is currently completing an MA in English at the University of North Texas at Denton.

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Need a Specialist for Your LAN Server 4.0?

By Brooks Hickerson, Yuangeng (Gene) Huang, and Phil Steinbach

Help is on the way! LAN Server Specialist (LSS), a productivity aid included with LAN Server (LS) 4.0, provides a problem determination tool for LS 4.0 administrators. It gathers the problems, offers suggestions, and learns from each incident. This article describes the timely operations of this handy tool, which is already available to you if you have LAN Server 4.0.

LAN Server 4.0's LAN Server Specialist (LSS) utility is a powerful problem determination tool that can help local area network (LAN) administrators quickly and easily determine the causes of LAN failures and recommend actions. LSS contains LSS Agents and an LSS Manager. In a LAN domain, the Agents are installed on each of the LAN Server (LS) servers and requesters to be managed, and the Manager is installed on the workstation the LAN administrator uses to manage the LAN domain (see Figure 1). LSS functions assist administrators by providing:

- *A focal point for problem determination.* LSS Agents receive errors, messages, and alerts issued by LAN servers and requesters, then forward them to the LSS Manager. The LSS Manager provides a graphical user interface (GUI) to review and manage reported problems.
- *Automatic, real-time event correlation and problem determination.* LSS provides real-time event analysis and problem reports. Events resulting from the same cause are combined in one problem report, which provides possible causes and recommends fixes.
- *A tool to customize and continuously improve the diagnostic capability of LSS.* LSS uses its knowledge of LAN Server error messages to analyze events. A GUI knowledge-base editor allows LSS administrators to customize the diagnostic knowledge base so the system's diagnostic capability is continuously improved.

LSS Operations

When you install an LSS Agent on the workstation to be managed, an LSS folder appears on the desktop with an LSS Agent icon in it. Double click on the icon to start the LSS Agent.

When you install an LSS Manager on the managing workstation (either a LAN Server or a domain controller), an LSS folder containing LSS Manager, LSS Agent, LSS Editor, User's Guide, and README icons appears on the desktop. Double click on the LSS Manager icon to bring up two consoles: the Machine Status Console and the Problem Report Console. The Machine Status Console displays the connectivity and operational status of each Agent, and the Problem Report Console displays the problems received from each workstation.

Machine Status Console

All domain workstations with an installed and running LSS Agent are listed in the Machine Status Console (see Figure 2). With LSS' auto-discovery capability, the LSS Manager can find all active LSS Agents in the domain when it starts, and LSS Agents can find the LSS Manager when they start. Thus LSS Manager and Agents can be started and stopped independently; the Machine Status Console always maintains a current list of Agents running in the domain.

The Machine Status Console list shows the Name, Status, Status Report Time, and Last Error Report Time for each workstation.

The workstation's *Status* options are Connected, Disconnected, and Broken. Connected is the normal status. A workstation is in Disconnected status if it is shut down (the machine is powered off) or the Agent has quit. A workstation is in Broken status if it has logged off from the domain.

The *Status Report Time* indicates the last time the workstation's status data was updated. The *Last Error Report Time* indicates the last time an error report was received from that workstation.

You can perform several actions from the Machine Status Console's menu bar. A workstation can be *paused*, meaning the Agent on that workstation is prevented from sending events to the Manager. This enables you to temporarily halt an Agent that is flooding the network with error messages. A paused workstation can be brought back to normal operation by *polling* it (inviting it to transmit).

A workstation can also be *deleted* from the workstation list. The deleted workstation's Agent is also prevented from sending events to the Manager. A deleted workstation can be brought back to the workstation list by the *Refresh Discovery* function.

The *Heartbeat* function detects workstations that are powered off abruptly. With the Heartbeat function turned on, the LSS Manager periodically polls workstations on the workstation list. If a polled workstation does not answer, its status is changed from Connected to Disconnected. You can turn the LSS Heartbeat function on or off and adjust the frequency of the polling.

Problem Report Console

As its name indicates, the Problem Report Console (see Figure 2) presents a list of problem reports, including each problem's

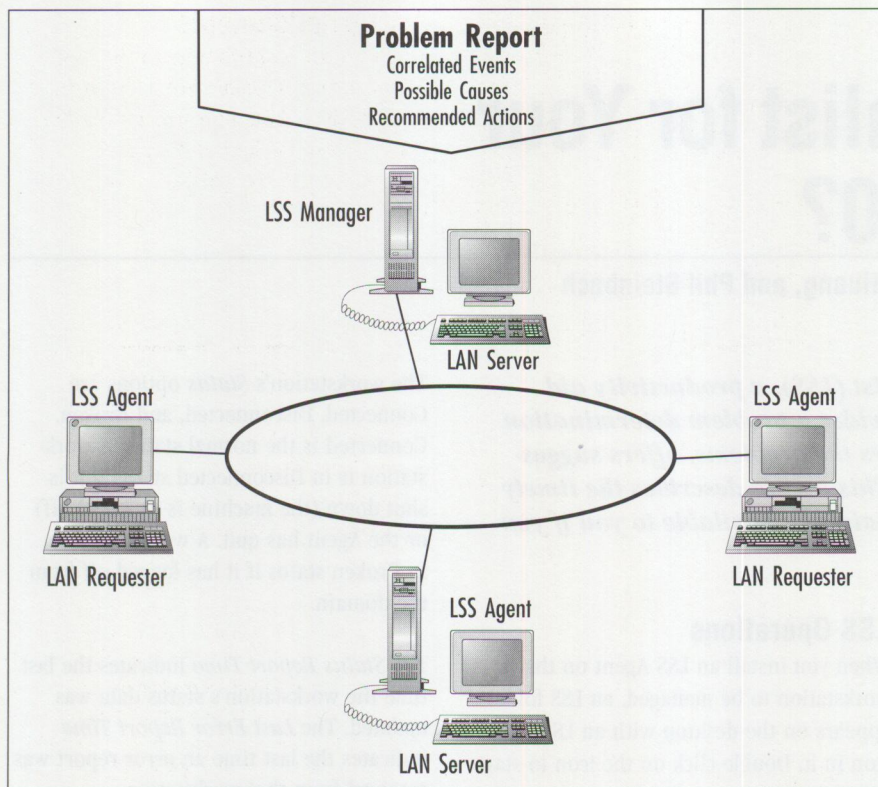


Figure 1. LSS Environment

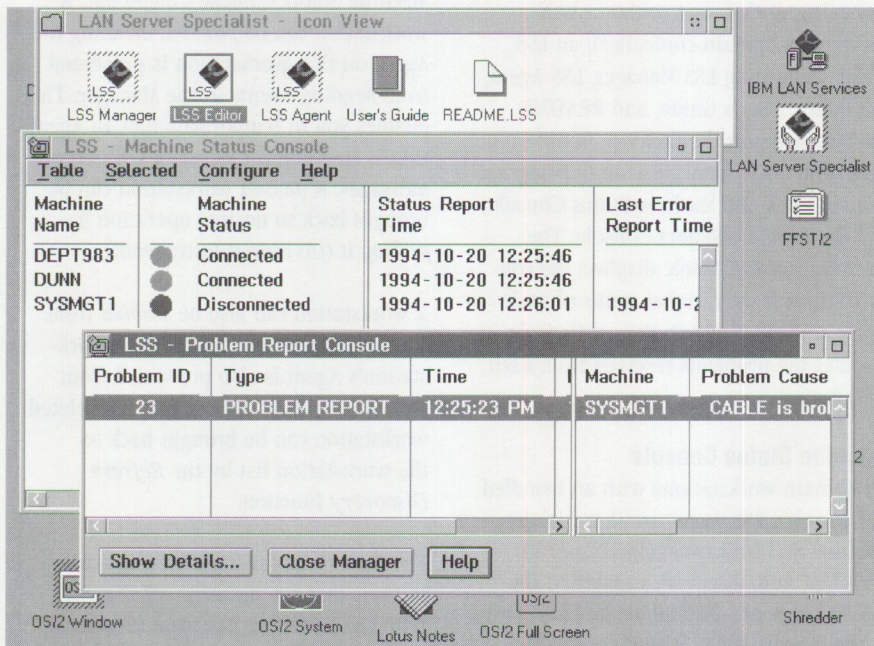


Figure 2. Machine Status Console and Problem Report Console

ID, Type, Time/Date, Machine, and Problem Cause.

The problem report ID is an integer assigned to a problem report.

Type includes Problem Report, Late Problem Report, Generic Alert, and

Unresolved Event. *Problem Report* indicates a "normal" problem report. A *Late Problem Report* is a report that was reported earlier but is updated when new information is received. A *Generic Alert* contains one event triggered by a software probe. The First Failure Support Technology (FFST) program creates a

generic alert using code point information defined by IBM and stores it at a generic alert receiver such as IBM's NetView/6000. (For more information about generic alerts, see *IBM LAN Server Version 4.0 Problem Determination Guide*). An *Unresolved Event* indicates that the knowledge base contains no information or no conclusion can be drawn. You can use the knowledge-base editor to add details about events.

Time/Date indicates the time and date that the problem occurred. *Machine* indicates where the problem occurred. *Problem Cause* specifies the nature of the problem.

From the problem report list, double click on a line to see the detailed report of a problem (see Figure 3). The detailed problem report panel contains three major sections:

- **Event(s) Correlated**—contains a correlated list of events. The event's information includes date and time, ID, and message text.
- **Possible Problem Cause(s)**—contains a list of possible causes including the workstation where the problem occurred and cause description.
- **Recommended Corrective Action(s)**—contains the corrective action to fix the cause selected in the second section. When a different cause is selected in the cause section, the corresponding corrective action is displayed here.

In addition to being listed in the Problem Report Console, problem reports are also logged into a flat ASCII problem report file in \IBMLSS\FXECPD.LOG.

Real-Time Problem Solving

The real power of LSS becomes apparent as it allows LAN administrators to continually improve the knowledge base as they gain more experience. LAN administrators can contribute their experience to the LSS knowledge base by using the knowledge-base editor to update causes and recommended actions. Using the knowledge-base editor results in several advantages:

- Newly identified causes can be added to the knowledge base to continually improve LSS' diagnostic ability.

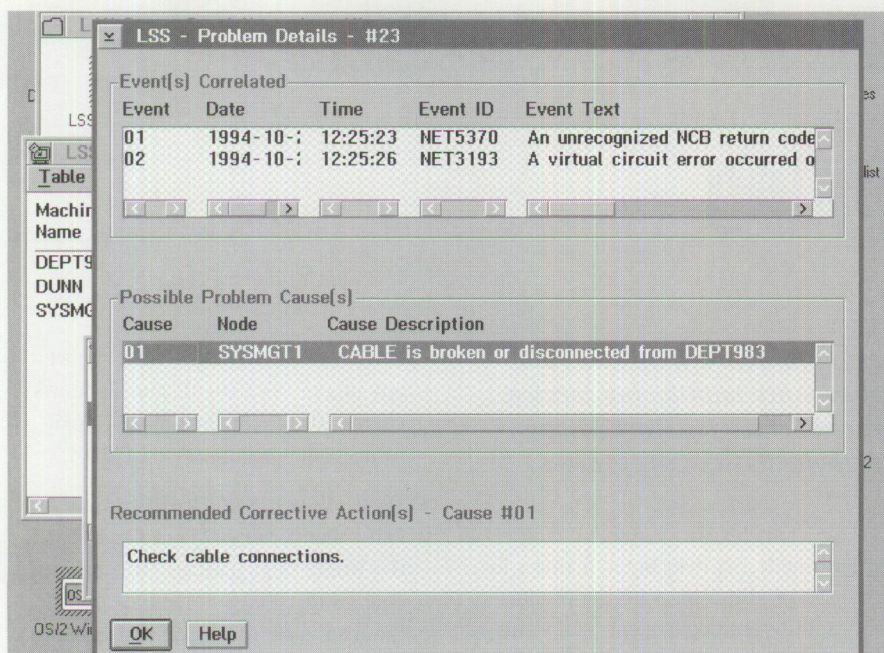


Figure 3. LSS Problem Details

- Site-specific problem determination information can be entered by LAN administrators to customize the problem-solving information.
- LAN administrators can share their accumulated problem-solving experiences through the knowledge base.

Consider the following simplified example: Error NET2140 (an internal LAN software error) occurs and a new cause (the network adapter hardware has failed) is found. You can then take the following actions:

- Create the cause with the knowledge-base editor.
- Associate NET2140 with the new cause.
- Create a recommended action: "call John Smith at 9-1234 or page him at 555-4321."
- Save the knowledge base.

If the NET2140 error occurs again, the cause, *the network adapter hardware has failed*, and the recommended action, *call John Smith at 9-1234 or page him at 555-4321*, will be in the problem report.

The relationships between errors and causes represented in the knowledge base can be much more complex than this example. Causes and actions can contain variables, which take different values based on the values in the incoming error

messages. The association between errors and causes can also be "conditioned," i.e., only when some other error occurs will a specific cause be associated with the error. The online documentation gives a detailed explanation for using the LSS knowledge-base editor.

Easy to Use

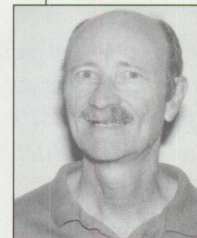
LSS has an online User's Guide that gives an overall introduction to the system's functions and a detailed description of how to accomplish each task. The system also has extensive online help to guide you through each task.

You can find LSS on diskettes #3 and #4 of LAN Server 4.0 Productivity Aids and install it directly on a server or across a LAN to other servers and requesters. The configuration/installation/distribution (CID)-enabled remote installation will help you put LSS on a code server, then remotely install LSS on each server and workstation on the LAN. The information file, README.LSS, describes the easy installation steps.

You must install the First Failure Support Technology (FFST) component of LS 4.0 on the managed workstation for the LSS Agent to run. The Agent requires approximately 400 KB of hard-disk space; the Manager requires approximately 3 MB of hard-disk space.

Acknowledgements

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One-Stop Shopping

By Fred Castañeda

Now everything you need to get your local area network up and running, complete with application and performance monitoring service, is available in one package—IBM's Advanced Server for Workgroups. This article describes this product, its components, and the process behind its ease of installation.

Implementing a workgroup computing environment with a groupware application—even with Lotus Notes, which stands out as the present standard—has not always been the easiest task to accomplish.

Whether the challenge was presented to a local area network (LAN) administrator in a corporate enterprise or to a value-added reseller, installing LAN software and workgroup applications was a time-consuming task.

Well, times have changed. Enter the IBM Advanced Server for Workgroups solution!

No, this is not a hardware PC server system—it's more like a software "bundle." But it is not just a series of products or part numbers thrown together and shrink-wrapped in a single package.

The IBM Advanced Server for Workgroups package is one of the first integrated product solutions for the groupware environment. Announced in mid 1994, this product brings together all the software needed to get a workgroup operational. It is available today in the United States and Canada.

The package consists of four software components:

- **Server operating system**—The package contains IBM OS/2, complete with Microsoft Windows 3.1 support for the server environment.
- **Network operating system**—IBM LAN Server 4.0 Advanced is included, providing file server, print server, and applications server capabilities to the

server node. Six distributed features for the server also come with the product. Thus, different departments can share DOS applications, Windows applications, and OS/2 applications from the LAN server.

- **Groupware application environment**—Lotus Notes is the application environment that comes with Advanced Server for Workgroups. In addition to a server license for Lotus Notes in the OS/2 environment, the product also comes with six additional client licenses. The

Lotus Notes installation can support any mix of OS/2 clients and Windows clients. The client code for both platforms comes on the same CD-ROM.

- **Load-balancing utility**—IBM's System Performance Monitor/2 2.0 rounds out the Workgroups package. This product enables the server to monitor use of the fixed disk, processor, and memory. It presents details graphically online as well as saves log files that can be analyzed later to find the performance bottlenecks. Add to this Theseus 2, a detailed memory analyzer, and you have a tool that can significantly help in performance tuning.

Instead of just throwing together four separate products into a box, IBM took



care to ensure that this product is as "plug-and-play" as possible.

More Than Just Software

In addition to these four software components, the true added value comes in the installation support and the packaging of Advanced Server for Workgroups, which includes:

- All software programs on CD-ROMs.
- An introductory videotape, which gives a brief product overview, a short demonstration of the finished application environment, and a graphical view of the installation process.
- An offer for savings on consulting services for Lotus Notes application development and implementation in the U.S.
- 90 days of free customer service and support from IBM (even for the Lotus Notes component) through an IBM 800 number in the U.S.
- One single, small, but powerful installation booklet, considered by some industry analysts to be the most valuable part of the product.

This "common installation guide," officially called *Getting Started*, provides a detailed, step-by-step approach to the installation of *all* the software components, from the server to all the clients. By following the instructions in this "cookbook," the LAN administrator can save the several days that it previously took to integrate and test the pieces of the network. Now, in just a few hours, the groupware environment is ready for productive use.

This installation guide allows Advanced Server for Workgroups to be a pre-packaged, pre-configured, and pre-tested product with everything needed for a six-user workgroup environment. The configuration supports both Token-Ring and Ethernet networks. The installation guide includes a case study, complete with worksheets and a default set of naming conventions.

In a product review, James T. Norman, contributing editor for *Andrew Seybold's Outlook on Professional Computing*, says the Advanced Server for Workgroups provides "... a powerful workgroup computing solution in a single box at a good price."¹

Customer Tested and Proven

The task of the "common installation"—integrating four components into a smooth step-by-step process—required that the installation have one and *only one* document: the *Getting Started* booklet. This is a 75-page document; the first 40 pages are instructions for the installation, and the remaining pages contain appendixes plus hints and tips for the groupware environment.

Usability Test

Three types of potential users thoroughly tested the installation process in the IBM Usability Test Lab in Austin:

- LAN administrators whose time is spent installing LANs, especially Novell NetWare and IBM LAN Server
- Application programmers whose primary function does not include LAN installations
- Novice users (that is, those with only DOS and Windows experience)

Based on comments and suggestions from the customers testing the process, the installation guide went through many revisions, resulting in a *Getting Started* booklet created by the potential users.

Certification

In addition to the usability test for the installation, the product also underwent a certification process in the IBM Integration and Test Laboratory in Austin. The seal on the back of the box states that the product has been "tested and approved for IBM LAN Systems." This means that this product passed many hours of installation tests, compliance tests, compatibility tests, and execution tests to ensure its reliability in real-world environments.

The tests are not limited to IBM products; other software manufacturers also use the Integration and Test Lab to certify their software products.

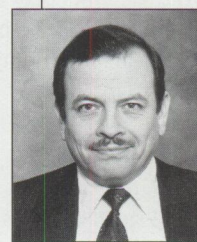
What's Next?

Today IBM Advanced Server for Workgroups provides the common installation process described in this article.

Future requirements for the product include the process known as "integrated installation." *Integrated installation* means that instead of following a

sequence of instructions and typing commands at the command line, the user is presented with a graphical user interface in an object-oriented environment, enabling icons and objects to be "dragged and dropped." The user only fills in the blanks or selects the items for naming conventions and other network information. With just a few clicks of a mouse on the installation screens, the whole installation is complete—from the server to the redirected download of code to the clients.

This is IBM LAN Systems' objective for future versions of this product and its derivatives in the world of server-based integrated products that provide customer solutions.



Fred Castañeda is a marketing brand manager for workgroup server products in IBM's Personal Software Products Division in Austin, Texas. He is responsible for product requirements, merchandising, marketing, and worldwide market support for the Advanced Server for Workgroups product. In his 17 years with IBM, he has worked in AIX technical support, PC applications marketing support, PC software product planning, as well as other support areas. He holds a BA and an MBA degree from Loyola University of Los Angeles.

¹ *Andrew Seybold's Outlook on Professional Computing*, Pinecrest Press, Inc., Brookdale, CA, Vol. 12, No. 12, July 1994, pp. 21-22.

OS/2® WARP

On October 11, 1994, IBM introduced OS/2 Warp Version 3, the next evolution of its premier 32-bit operating system. As its name implies, OS/2 Warp is fast and full of state-of-the-art features. This article describes the new features of OS/2 Warp, including performance enhancements, installation enhancements, usability improvements, printing enhancements, new applications, and more. Read on, and see what it's like to operate at Warp speed!

OS/2 Warp Version 3, the eighth release of IBM's award-winning 32-bit OS/2 operating system, continues the tradition of running DOS better than DOS, Windows better than Windows, and OS/2 better than previous versions of OS/2. OS/2 Warp builds on the mature, stable environment that comes from years of refining the OS/2 operating system.

You can run OS/2 Warp on an entry-level computer system, typically 386 or above, with 4 MB of RAM.

Although OS/2 Warp is targeted for the home and small business user, all users can benefit from its great performance, new function, and outstanding BonusPak applications.

Edward Duhe'
IBM Corporation
Roanoke, Texas

This article outlines what is new in OS/2 Warp, focusing on the enhancements and changes in OS/2 itself. Also, it briefly describes the applications included in the OS/2 BonusPak that comes with OS/2 Warp. The BonusPak is an exciting addition to OS/2; it gives you full-function business and productivity applications and outstanding connectivity applications that will connect you to the information superhighway.

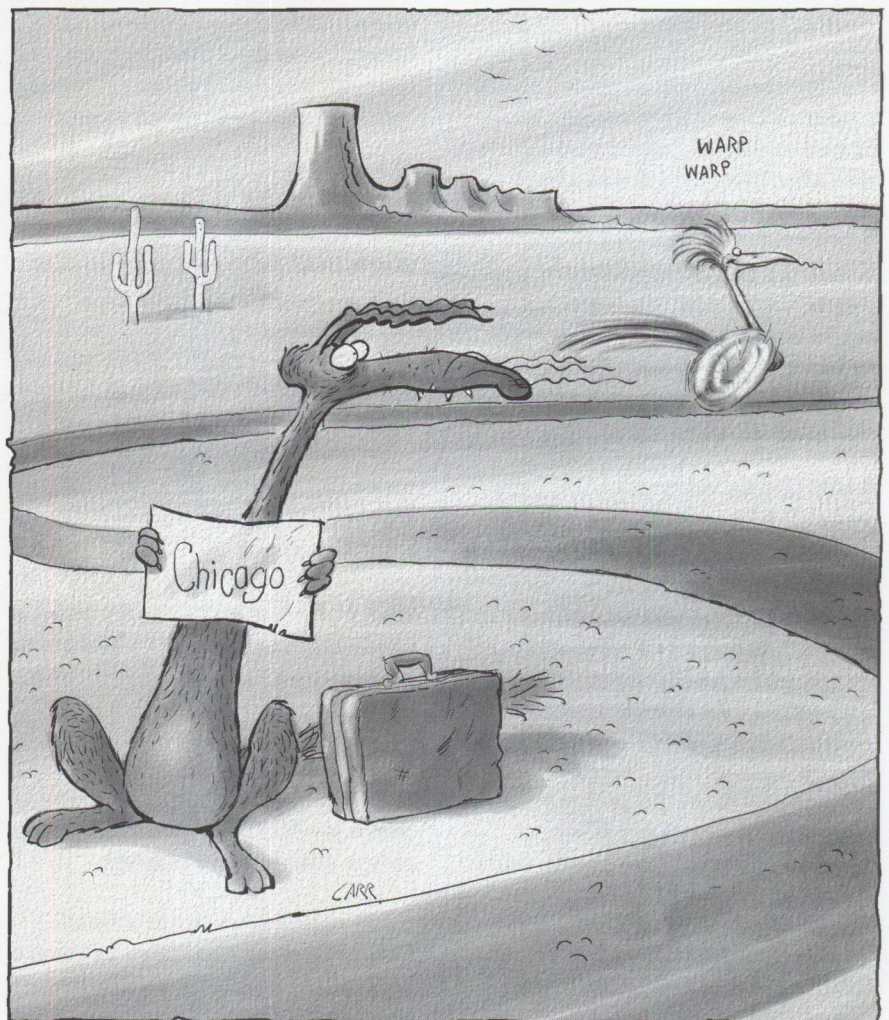
Two OS/2 Warp Products

OS/2 Warp Version 3 is available today, and OS/2 Warp Version 3 with WIN-OS/2 will be

available in the first quarter of 1995. The only difference between these two products is how you get support for running Windows applications.

With OS/2 Warp Version 3, you must have Windows installed on your computer to run Windows applications on the OS/2 Desktop. OS/2 Warp dynamically links into your Windows code, when needed, to run your Windows applications.

OS/2 Warp Version 3 with WIN-OS/2 does not require Windows to run Windows applications. This version comes with



WIN-OS/2, which provides the support for Windows applications.

Both of these products can be installed in three different environments that provide different capabilities.

■ *No operating system previously installed:* If you install OS/2 Warp Version 3 on a computer that does not already have an operating system installed, you will be able to run both DOS and OS/2 applications on the OS/2 Desktop. If you install OS/2 Warp Version 3 with WIN-OS/2, you will be able to run DOS, OS/2, and Windows applications on the OS/2 Desktop.

■ *DOS previously installed:* Either OS/2 Warp Version 3 or OS/2 Warp Version 3 with WIN-OS/2 can be installed on a computer that already has DOS 3.3 or higher installed. OS/2 Warp will automatically install the Dual Boot feature in this environment. This feature enables you to boot your computer to run either native DOS or OS/2.

If you install OS/2 Warp Version 3 in this environment, you can run both DOS and OS/2 applications on the OS/2 Desktop. If you install OS/2 Warp Version 3 with WIN-OS/2 in this environment, you can run DOS, OS/2, and Windows applications on the OS/2 Desktop.

■ *DOS and Windows previously installed:* This is the environment for which OS/2 Warp Version 3 was really designed. By installing OS/2 Warp Version 3 on top of DOS and Windows, you will be able to run DOS, Windows, and OS/2 applications on the OS/2 Desktop. You will also be able to take advantage of the Dual Boot feature to run in a native DOS plus Windows environment.

OS/2 Warp Version 3 installs over Windows 3.1, Windows 3.11, Windows for Workgroups 3.1, and Windows for Workgroups 3.11.

OS/2 Warp Version 3 with WIN-OS/2 will also install in this environment, giving you the same capabilities described for OS/2 Warp Version 3.

Also scheduled to be available during the first quarter of 1995 is OS/2 Warp Version 3 LAN Client. This member of the OS/2 family is targeted at the LAN connected user. OS/2 Warp Version 3 LAN

Client will include OS/2 Warp Version 3 with WIN-OS/2, the OS/2 Warp BonusPak, plus LAN Server Requester, NetWare Requester, LAN Distance Remote, System Performance Monitor/2 (SPM/2), and many other features designed for the connected user.

Enhanced Performance

OS/2 Warp has been re-engineered to appeal to a much larger audience, including users of entry systems—those that are typically found in the home or small-business environment. These systems usually have few resources, including limited memory. The re-engineering of OS/2 focused on accommodating these entry systems.

Reduced Memory Requirements

One main design focus was performance and system requirements. When OS/2 2.x was announced, the minimum system requirement was stated as 4 MB of RAM. Although it was possible to run OS/2 2.x in 4 MB, the performance was, for the most part, unsatisfactory. By adding just 2 MB of RAM to your 4 MB OS/2 2.x system, you could gain significant performance advantages.

You will find that OS/2 Warp's performance on an entry-level 4 MB system is comparable to OS/2 2.11's performance on the same system with 6 MB.

Even on computers with 8 MB, 16 MB, 32 MB, or more of RAM, you will still see a faster-running system under OS/2 Warp. On a high-memory system, OS/2 Warp's windows pop up faster, the populating of objects in a folder is faster, and the system runs more efficiently overall.

With its increased performance and decreased system requirements, OS/2 Warp is an excellent operating system choice for most personal computers shipping today.

Tuned-Up 32-Bit Window Management

The OS/2 Warp developers have extensively reprogrammed and tuned the OS/2 kernel so that the system operates more responsively. Even though the kernel requires fewer system resources to run, it does not lack any features found in earlier kernels.

Performance gains were achieved by rewriting the OS/2 window-management system (PM-WIN) as 32-bit code and combining several of the PM-WIN dynamic link libraries (DLLs).

The 16-bit version of PM-WIN was a performance bottleneck, because on either side of the 16-bit PM-WIN component were the 32-bit shell (PMSHELL) and the 32-bit graphics engine (PMGRE). This scenario caused a large amount of "thunking" (converting 32-bit addresses to 16-bit, and vice versa) between the 32-bit components and the 16-bit PM-WIN.

Merging PMWIN.DLL with PMGRE.DLL and PMSHAPI.DLL into a single DLL called PMMERGE.DLL improved PM-WIN's performance as well. The logic is that the fewer DLLs required for the PM-WIN function, the less overhead required.

Improved Paging Subsystem

The paging subsystem was tuned to improve performance. It now uses memory more efficiently so that the most frequently used pages are in memory when needed. This reduces the amount of paging or swapping to disk, thereby reducing the overhead and time necessary to perform paging.

Enhanced Workplace Shell

The Workplace Shell includes performance enhancements, particularly during loading. The time it takes to populate folders, open objects, and load applications is faster than in earlier versions of OS/2.

There is now a fast-load option for Windows applications. In OS/2 2.x, when loading a Windows application, DOS was loaded first, then a Windows kernel, and finally the application. Once your first Windows application was running, and if you were using a shared Windows kernel, the next Windows application would load more quickly. This happened because DOS and the shared Windows kernel were already loaded by the first application.

With the new fast-load option enabled in the WIN-OS/2 Settings notebook, OS/2 Warp starts an OS/2 Windows session at startup. This OS/2 Windows session does not show up in the window list but is used by Windows applications that are started from the Desktop, allowing them to load more quickly. Windows programs that are set to run in a separate OS/2

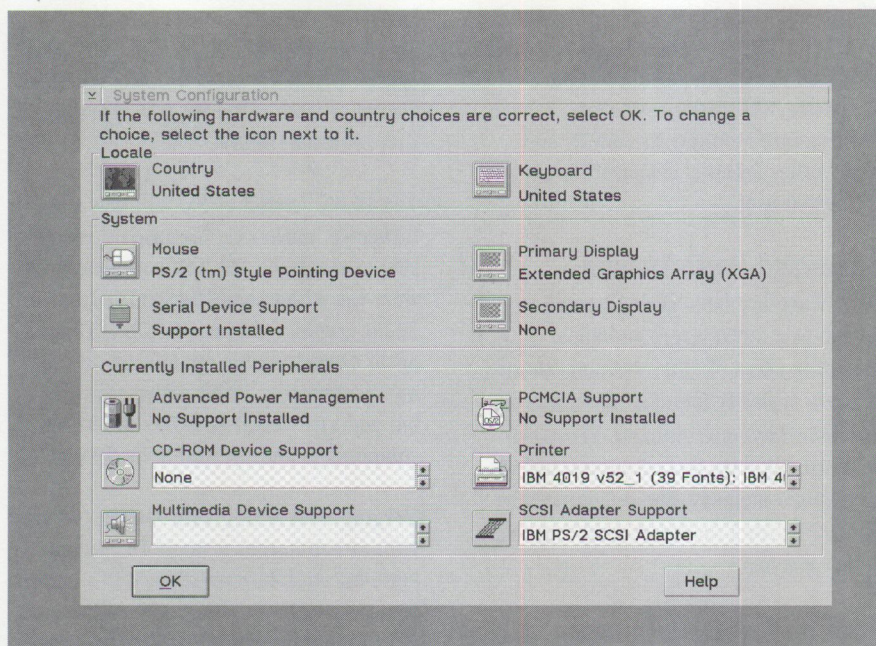


Figure 1. System Configuration Screen

Windows session do not benefit from the fast-load option.

Enhanced Installation

OS/2 Warp installation is greatly enhanced over OS/2 2.x. Most of the enhancements make installation much easier for the novice user. In the past, you had to identify your personal computer hardware to the OS/2 installation program for it to install the proper configuration. The OS/2 Warp installation program, on the other hand, determines what kinds of hardware your computer has and decides which configuration it should install to support that hardware.

An Easy Installation option allows you to install OS/2 Warp with minimal interaction, while an Advanced Installation option gives you complete flexibility in installing and configuring your system. There are also some changes that affect the installation regardless of which option you select.

Easy Installation

The Easy Installation option is new in OS/2 Warp. Easy Installation lets you install OS/2 Warp with the push of one button—you don't have to answer questions or make decisions along the way.

When you select the Easy Installation option, the installation program detects what types of devices you have installed

in your computer and selects the appropriate device drivers to support your hardware. For example, the installation program detects if you have a CD-ROM, and (if so) what type. It also detects your video type, whether you have a sound card, and much more.

The installation program then displays a configuration screen (see Figure 1), allowing you to verify the selections it has made. If you are satisfied with the installation program's selection, you click on the OK button to begin the installation.

In Easy Installation, the installation program always installs OS/2 Warp onto drive C:. If you want to install it onto a drive other than C:, you must use the Advanced Installation option.

The installation program installs components of OS/2 Warp based on your computer's hardware. For example, if the installation program detects Advanced Power Management (APM) capability in your computer, it installs the Advanced Power Management support for OS/2.

Other than inserting the proper diskettes when prompted, all you have to do is shut down, then reboot OS/2 Warp.

Advanced Installation

The Advanced Installation option is very similar to OS/2 2.x's installation, with some notable exceptions.

Once you select the drive on which to install OS/2 Warp, you see the same System Configuration Screen displayed by Easy Installation (Figure 1). Just as in Easy Install, you can make changes to the system's selections, which OS/2 Warp made by detecting the hardware.

When installing OS/2 2.x, you were presented with a selection screen where you could "Learn the mouse," "Install pre-selected features," "Install all features," or "Select features." These options are not provided in OS/2 Warp. Instead, you are presented with the OS/2 Setup and Installation screen (Figure 2) where you can select the components you would like to install.

When installing OS/2 2.x, you were asked to make decisions about the installation at several different points within the installation process. For example, it wasn't until after all the diskettes were copied that the installation program asked you about migrating applications. In OS/2 Warp's installation, all of the questions are asked at the same time. As soon as you finish with the Setup and Installation screen, you are asked about application migration. Only after you answer all questions and make all decisions does the installation continue. Beyond that, you need only change diskettes as requested by the installation program until the installation is complete. Reboot, and your system is ready to run!

Automatic Changes to DOS CONFIG.SYS

Previous versions of OS/2 required manual changes to the DOS CONFIG.SYS file when installing the dual-boot feature. OS/2 Warp automatically installs the dual-boot feature when installed on a computer that is already running DOS and automatically modifies the DOS CONFIG.SYS files without requiring a reboot.

New BOOT Parameters

The BOOT command, used to boot between OS/2 and DOS in a dual-boot environment, has some new parameters. You can now issue a BOOT command with a /N parameter, for NOBOOT. This allows the boot records to be changed as before, but it suppresses the reboot and allows you to do an orderly shutdown. BOOT /Q displays which operating system (OS/2 or DOS) is designated to boot next.

New Diskette Format

The installation time has been reduced with OS/2 Warp. Also, the number of diskettes has been reduced by utilizing a new state-of-the-art compression algorithm called eXtended Density Format (XDF) technology. XDF extends the capacity of a 2.0 MB diskette from 1.44 MB to 1.86 MB, which reduces the total number of diskettes required. All of the diskettes are in 1.86 MB XDF format except the installation diskette and Diskette 1, which are still in 1.44 MB format.

Be aware that if you try to display the directory listing of an XDF diskette on an OS/2 2.x system, you will get a "File not found" error. This doesn't mean your diskettes are bad. To access the XDF diskettes, you must first load XDFLOPPY.FLT and a new version of either IBM1FLPY.ADD or IBM2FLPY.ADD in your CONFIG.SYS file.

XDF diskettes have a software write protection. This means that the XDF diskettes are read-only. You cannot write to or erase from any of the XDF diskettes. Use the XDFCOPY command to make copies of the diskettes.

Multimedia Installation

In OS/2 2.x, you had to install multimedia support separately from the OS/2 installation program. In OS/2 Warp, multimedia installation is integrated into the installation program; multimedia installs automatically when the appropriate system hardware is detected or when selected from the OS/2 Setup and Installation screen.

By default, the installation program does not install Multimedia Presentation Manager/2 (MPPM/2) or High-Performance File System (HPFS) if your system has less than 6 MB of RAM; however, you can use the Selective Install to add this support.

Multiple Printer Installation

OS/2 Warp's installation process allows you to install multiple printers. Previously, you could install only one printer during initial installation, requiring a much more complex process to install additional printers later. In OS/2 Warp, you can select multiple printers and assign them to the appropriate ports during the initial installation, so that all of your printers are available after installation.

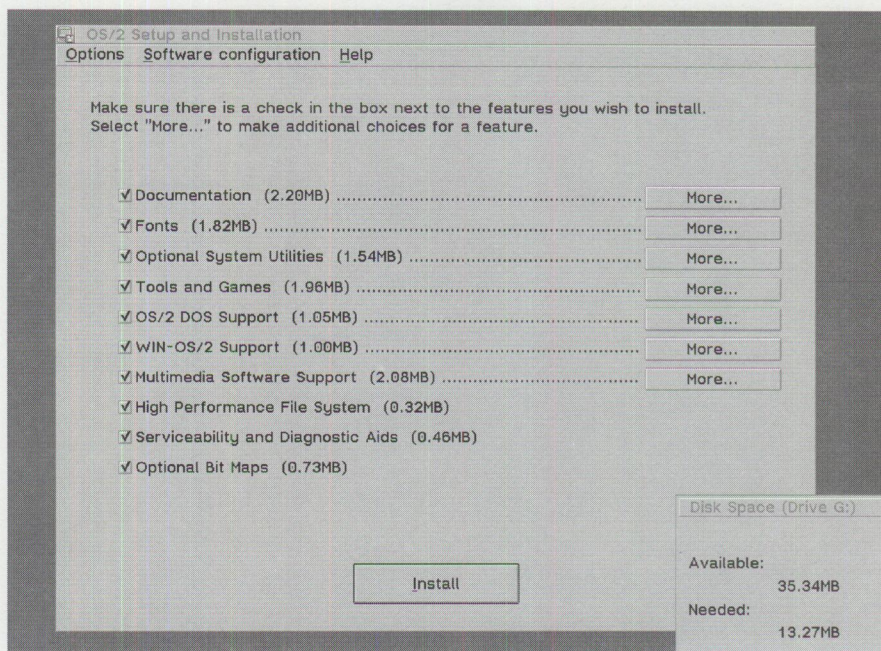


Figure 2. OS/2 Warp Setup and Installation

Device-Driver Resource Manager

OS/2 Warp now benefits from a device-driver Resource Manager. The Resource Manager is itself a device driver that manages other device drivers and determines how they load. During installation, the Resource Manager scans input/output (I/O) ports, interrupt requests (IRQs), memory, direct memory access (DMA) arbitrations, and timers in an attempt to resolve conflicts between two device drivers.

A device driver must ask the Resource Manager for access to a port before it can load at that location. The Resource Manager determines if there is already a device driver loaded there. If not, the requesting driver is allowed to load. If a driver is already at that location, the Resource Manager scans to find another location for the device driver to load. This avoids system hangs from device-driver conflict in an industry standard architecture (ISA) bus system.

For more information about the Resource Manager and how to interact with it, type RMVIEW ? on an OS/2 Warp command line.

Larger Migration Database

The Migrate Application function of the installation process has been enhanced by the addition of more than 300 popular DOS applications and games. OS/2 Warp

automatically configures the DOS and Windows settings for these applications to optimize their performance in the OS/2 environment.

Selective Uninstall

Another enhancement is the capability to uninstall components of OS/2 Warp. Through the "Selective uninstall" object in the OS/2 System Setup folder, you can remove features you don't want or use, thus freeing up disk space on your system.

Installation Media

OS/2 Warp supports installation from diskette and CD-ROM as well as remote installation via redirected installation and through the unattended configuration/installation/distribution (CID) process. Multimedia and the additional BonusPak applications are not CID-enabled.

Enhanced Usability

Usability enhancements in OS/2 Warp include an improved Tutorial, a new LaunchPad, and a dynamic Libpath.

Tutorial

The Tutorial in OS/2 Warp has been completely redone. It guides you through an overview and tells you how to manipulate objects, set up applications, customize your Desktop, and more.

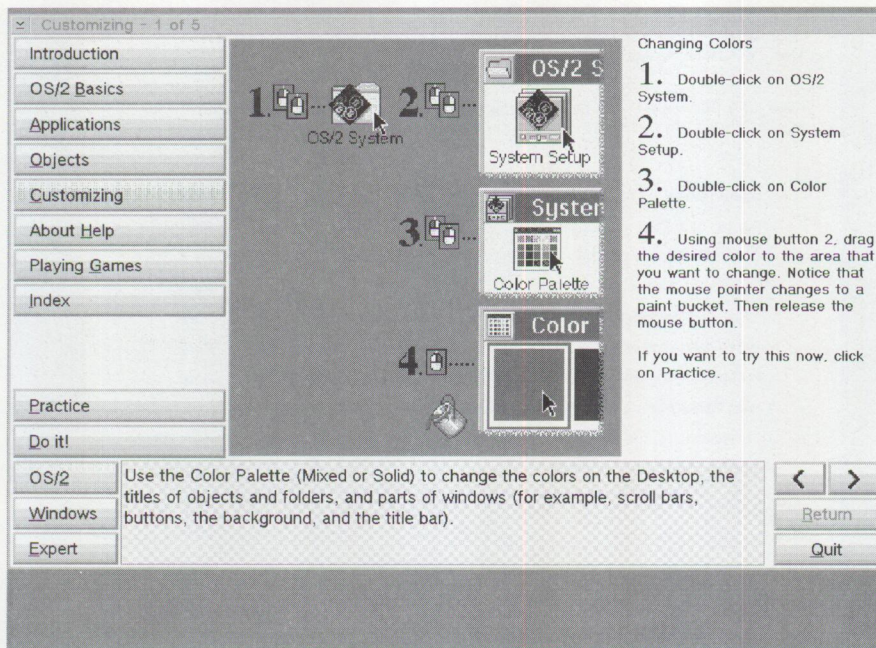


Figure 3. OS/2 Tutorial

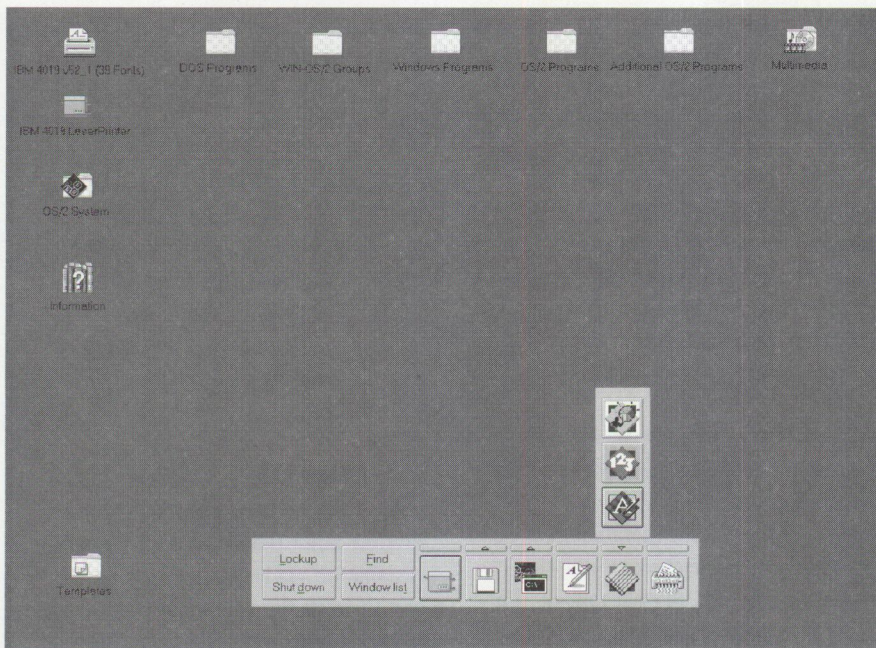


Figure 4. The OS/2 Warp Desktop and LaunchPad

The Tutorial has features such as the "Practice" button and the "Do it" button (see Figure 3). With these buttons, you can practice what the Tutorial is teaching you, as well as actually perform that function from within the Tutorial.

For example, if you are in the color customization section of the Tutorial, and you select the practice button, the Tutorial takes you back to your Desktop and displays a window with step-by-step instructions for getting to the color

palette, changing colors, and getting back to the Desktop. To return to the Tutorial, just select the return button displayed with the step-by-step instructions. If you select the "Do it" button, the Tutorial brings up the color palette and allows you to drag and drop colors on your objects. To return to the Tutorial, just select the return button, and you will be right back where you were.

Another nice Tutorial feature is that it provides information from several different

user perspectives: a new user to OS/2, a user who is already familiar with Windows, and (for the expert user) some advanced tips from OS/2 experts. A message window displays text explaining the content of the currently selected topic and how you might want to use that information.

By default, the Tutorial displays information for the new OS/2 user. If you select the Windows button, you see a comparison of Windows and OS/2 and an explanation of the different terms used in each environment. And, as mentioned above, the Expert button provides you with helpful ideas about the topic from expert OS/2 users. For example, under the Desktop topic in the Tutorial, the following messages are displayed for each of the three different types of users:

- **OS/2**—The Desktop is a view of your work. The items on the OS/2 Desktop represent items you normally have in your room (for example, file cabinet, printer, folders, documents, shredder). These items are called objects.
- **Windows**—The OS/2 Desktop is similar to the Windows Program Manager, although the Desktop includes additional functions. OS/2 objects are like icons in the Windows Program Manager.
- **Expert**—All objects on the Desktop, including those you add, are stored in the Desktop directory on the drive where OS/2 is installed (typically drive C: or D:). Open the Drives folder to access the drive and the Desktop directory.

The Tutorial also has an index and graphical help that you can use for reference.

LaunchPad

The LaunchPad, shown at the bottom of Figure 4, is a special tool bar on the OS/2 Desktop. Any object placed on the LaunchPad can be accessed with a single mouse click. By putting your frequently accessed programs on the LaunchPad, you can have quick, easy access to them.

Following are several interesting aspects of the LaunchPad:

- You can easily add an object to the LaunchPad by simply dragging and dropping the object onto it. To delete an object from the LaunchPad, drag the object you want to delete and

drop it onto the shredder object. Regular-size icons can be used on the LaunchPad, or mini icons can be used to reduce its size.

- The LaunchPad can be made to float on top of the Desktop so that it is always visible, and it can be oriented either horizontally or vertically. If your LaunchPad is behind other windows and folders, you can bring it to the top quickly by double-clicking on the white space inside a folder.
- The LaunchPad has drawers that can contain more objects. These drawers can be detached and placed anywhere on the Desktop that is convenient for you.
- LaunchPad objects are shadows of other objects that can be customized through their Settings notebooks.
- Many system functions such as lockup, shutdown, find, and invoking the window list are on the default LaunchPad.

Dynamic Libpath

The Libpath statement in the CONFIG.SYS file has been a part of OS/2 through all of its versions. The Libpath statement globally defines directories to be searched for dynamic link libraries (DLLs) when OS/2 programs are loading. Because this parameter, in previous OS/2 versions, was set globally for the entire system, it could be specified only in the CONFIG.SYS file. This meant that any changes to the Libpath statement required a reboot in order to take effect.

OS/2 Warp's dynamic Libpath enables you to specify a different Libpath setting for each program session. There are two settings variables: BeginLibPath and EndLibPath. BeginLibPath allows you to specify directories to be searched before the system global Libpath directories. EndLibPath lets you specify directories to be searched after the BeginLibPath and system global Libpath directories. Both BeginLibPath and EndLibPath can be set with the SET command or through application programming interfaces (APIs).

A dynamic Libpath can be very helpful in a network environment. Suppose you have an application that requires a Libpath statement to point to a directory on the file server to find the necessary DLLs to run the application. Before OS/2

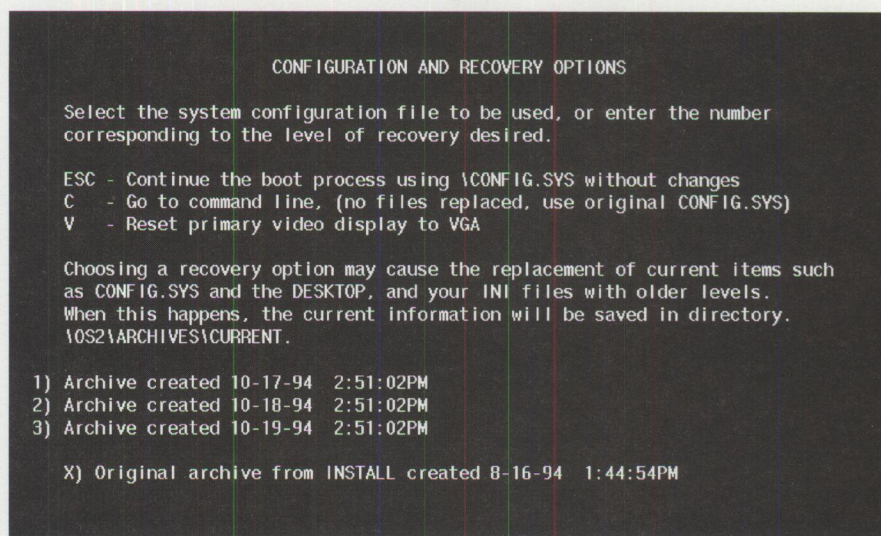


Figure 5. OS/2 Warp Boot Configuration and Recovery Options

Warp, you would have to modify the Libpath statement in the CONFIG.SYS file for each workstation that needed to run this application. Now, with OS/2 Warp's dynamic Libpath, you can create a CMD file with a SET BeginLibPath statement that points to the directory containing the DLLs and then loads the application. No changes have to be made to the workstations.

Enhanced Boot Options

When you boot OS/2 Warp, you will notice a white area with "OS/2" printed on the side of it in the upper left corner of your screen. When this white area appears, you can invoke some special functions during the boot process.

Alt+F1

You may be familiar with the Alt+F1 key sequence from previous versions of OS/2; it was used to recover your OS2.INI, OS2SYS.INI, and CONFIG.SYS files. This key sequence copied versions of these system files stored in the OS2\INSTALL subdirectory over the current files before booting the system. This was a good way of recovering these files if they were corrupted. The problem was that unless something was done in the meantime to update the files in the OS2\INSTALL directory, these files were the system's default files. This meant that your desktop was returned to the default desktop that you had immediately after installation. All your customizing was lost.

In OS/2 Warp, the Alt+F1 key sequence does things a bit differently. When you

press Alt+F1 under OS/2 Warp, the system displays a menu titled Configuration and Recovery Options (see Figure 5). On this menu you have several choices. The first is to press Esc and continue the boot process without changing anything. The second is to press C to get an OS/2 command line so that you can make changes to your system manually. The third option is to press V, which resets the system to VGA mode. This allows you to boot in situations where you may not have specified the correct video drivers.

Archived Desktops

The Desktop's Settings notebook now has an Archive tab. When Archive is selected, the system will keep up to three generations of archives of your system files (OS2SYS.INI, OS2.INI, CONFIG.SYS, and STARTUP.CMD) and your customized Desktop settings.

After you have enabled the archive feature, the Alt+F1 boot menu displays the archives with their dates and times and gives you the ability to restore one of your archive sets. Each one of the archive sets is numbered, with 1 being your most recent archive and 3 your oldest. When you select one of these numbers, the system replaces your current system and Desktop files with the previously archived ones. The fourth option, (X), is to restore the original system files and Desktop from when the system was first installed. These new features provide a better chance of recovery if your system files or Desktop get corrupted.

Alt+F2

Alt+F2 provides valuable information when troubleshooting problems on your system. When you press Alt+F2 while the white area is on the screen, the system displays real-time information as the system boots.

As device drivers are loaded, the DEVICE statements are displayed at the bottom of the screen. This enables you to see the last driver executed if the system hangs while processing the CONFIG.SYS file. The last driver displayed is probably the one causing your boot problem. Now you can take steps to remove or correct that driver.

Enhanced Formatting

OS/2 Warp now supports fast File Allocation Table (FAT) formatting. Fast format, which is activated with the /Q option on a FORMAT statement, deletes the File Allocation Table and boot sectors without actually scanning the disk for bad sectors. As a result, the fast format completes in a fraction of the time of a regular format. Fast format is the default when formatting hard-disk drives, because today's hard disks seldom have any bad sectors. Diskette formatting defaults to the regular format. Fast format should only be used on diskettes that have already been formatted with the regular format that scans its sectors.

Enhanced Workplace Shell

The Workplace Shell's Desktop now has a new look (see Figure 4). The default colors are bright rather than gray as in earlier versions of OS/2. The icons have been redesigned in three-dimensional color, giving the desktop a spiffier look. Some of the icons are animated. For example, when you open a folder, the icon changes from a closed folder to an open folder, as shown in Figure 6. An open folder is still cross-hatched to show that it is open, but the animation provides another visual clue to the state of an object.

Settings Pop-Up Menu

To access an object's Settings notebook in previous versions of OS/2 you had to press mouse button 2 while the pointer was on the object, then select the arrow next to the Open option on the pop-up window. This caused another window to cascade; from there you could select the Settings notebook.

In OS/2 Warp, the Settings option has been moved to the primary pop-up window, right under the Open option, making it quicker and easier to access. An even easier way to bring up an object's Settings notebook is to hold down the Alt key and double-click mouse button 1 on the object.

Automatic Migration

OS/2 has a database containing settings for hundreds of applications. OS/2 2.x required you to select the Migrate Applications program to scan your drives and to match applications with the proper settings, thus adding them to your Desktop. In OS/2 Warp, this process is automatic when you add applications through a program template. If you drag a program template to the Desktop, then enter the name of the program to execute, OS/2 Warp automatically tries to match it to the database. If a match is found, all the settings defined for that application are loaded for your program object.

Sort

The OS/2 Workplace Shell lets you sort the contents of your Desktop or folder. In previous versions of OS/2, you were able to sort the objects by name, type, real name, size, last write date, and last access date. OS/2 Warp now lets you also sort the objects by creation date and time.

Find and Include

Workplace Shell's find capability has been greatly enhanced. It is now much simpler and much faster. You can specify extensive criteria for including or excluding objects. OS/2 Warp adds Object title, Object style, Object class, Read-only flag, Hidden flag, System flag, Directory flag, Archived flag, Subject, Comment, Key phrase, History, and Extended attribute size to the existing OS/2 2.x criteria for include and find. You can also save the objects found as shadows or just view them in the find container. Find is now in its own thread, so it doesn't restrict you from doing something else while it is running.

Pickup and Drop

The new pickup and drop feature in OS/2 Warp allows you to drag and drop an object without having to hold down the mouse button in the process. When you single-click mouse button 2 while the pointer is on the object, the object's pop-up menu is displayed. From this pop-up menu you can select Pickup. Once you

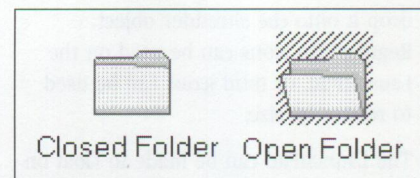


Figure 6. Animated Icons in OS/2 Warp

have "picked up" the object, point to where you would like the object placed, and press mouse button 2. This displays a Drop selection on a pop-up menu.

You can use the pickup function without having to go to the pop-up menus by using the following key combinations:

- Alt+mouse button 2 to pick up
- Shift+mouse button 2 to drop/move
- Ctrl+mouse button 2 to drop/copy
- Ctrl+Shift+mouse button 2 to drop/create shadow

Color Palette

Two color palettes are available in OS/2 Warp. The default color palette is 16 solid colors, and a 256-color palette is available for systems with SVGA display resolution.

Enhanced Folder/Desktop Setting

In OS/2 Warp, you can control the settings for icon text and the background for folders and the Desktop through the View tab in the Settings notebook (see Figure 7). You can change the font used for the icon text by dragging and dropping a font from the font palette or using the Change Font button in the notebook. You can specify icon text color, set the text to be visible or not, and set the icon text background to transparent or non-transparent. Using a non-transparent setting shows the icon text on top of a "slab," thus making the icon text visible and readable when displayed on top of a busy background bitmap.

The background bitmap can now be specified as part of a scheme that can be used to change the look of the Desktop or a folder. There is a preview area on both the View and Background page of the Settings notebook. The View preview area can accept a drop from the color palette and the font palette. The Background preview area can accept a drop from the color palette or from a bitmap object in a folder. The Lockup settings preview area in the Desktop Settings notebook will also

accept a drop from the color palette or from a bitmap object.

Schemes

Included with OS/2 Warp are 28 redesigned schemes in the Scheme palette. These schemes have separate settings for the Desktop folder and any other folder. This allows you to create a scheme that you can drag and drop to the Desktop while holding the Alt key, changing your entire system's appearance. For example, you can specify a background bitmap and icon text background color for your Desktop but not for its folders.

System Pointers

OS/2 Warp gives you the capability to change the system pointers. These pointers can be changed individually or in sets. OS/2 Warp comes with four sets of pointers you can choose from, or you can create your own. Pointers are specified in the Settings notebook for the mouse.

Undo Arrange

A common situation in previous versions of OS/2 was the accidental arrangement of the Desktop. Many users had customized the arrangement of icons on the desktop in a way other than the system's default arrangement. Accidentally choosing the Arrange option in the Desktop's pop-up menu caused your icons to be placed (arranged) into rows at the top of your screen. After that, you had to re-customize your Desktop to your liking. In OS/2 Warp, whenever the Arrange option is selected, you are given an Unarrange option in the pop-up menu to restore your customized Desktop arrangement.

Enhanced Folder Open/Close

The "Folder automatic close" setting allows you to specify that a folder automatically close when an object contained within that folder is opened. Using this feature can help you keep your Desktop from getting cluttered with numerous open folders.

This option can be set as the system default on page 2 of 3 in the System Settings notebook; it can also be set on page 2 of 2 in the Settings notebook for an individual folder.

Settings options are: (1) Never automatically close the folder; (2) Close the folder when opening a subfolder only, or

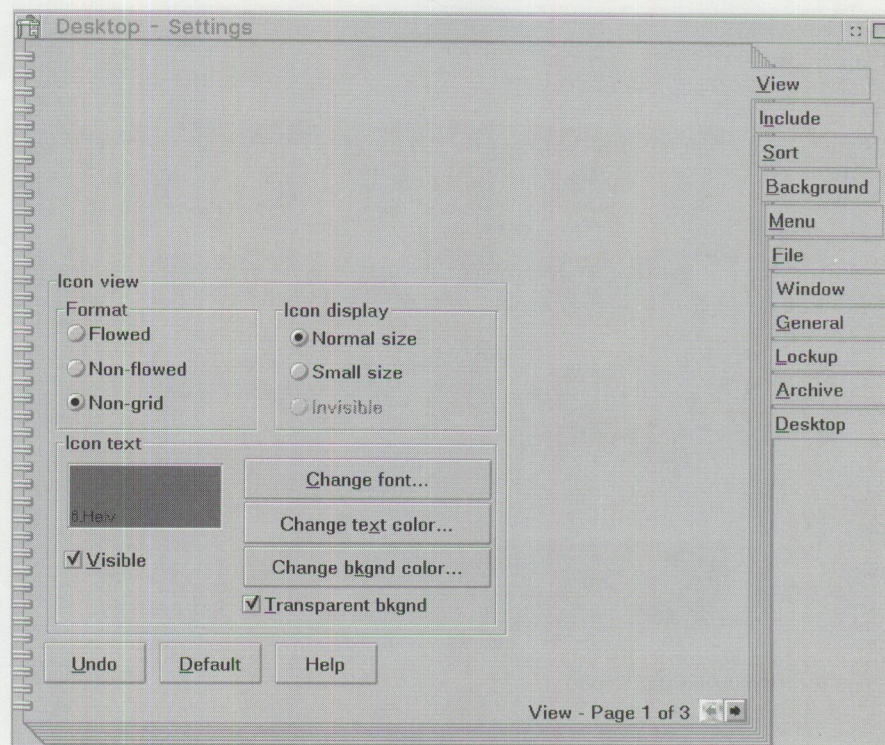


Figure 7. View Tab in Desktop and Folder Settings Notebooks

(3) Automatically close the folder when any object in the folder is opened.

"Open parent," a new pop-up menu option, has been added to the folder objects. This option provides a convenient way to re-open the (parent) folder that contains the (child) folder that you are currently viewing.

Enhanced Printing

Printing performance is enhanced by a new 32-bit printing subsystem. The graphics engine, print spooler, and most print drivers are now 32-bit.

The PRINT0x.SYS parallel port device driver now defaults to using a polling system instead of interrupts on an ISA system. Polling can eliminate some problems with hardware IRQ incompatibilities, enabling the use of printer-sharing devices and some I/O boards, as well as freeing up interrupts 5 and 7 for use by other devices.

Polling increases throughput performance by eliminating the CPU overhead of an interrupt context switch for each byte printed. Polling can be disabled by placing the /IRQ switch on the PRINT0x.SYS driver in the CONFIG.SYS file. If DMA is enabled for the port, then the interrupt method will be used by default.

OS/2 Warp has a new OMNI.DRV print driver. This driver encapsulates all Paintjet, Deskjet, and Epson print drivers. The OMNI driver takes full advantage of the new Soft Draw function for rasterizing bitmaps, increasing the performance and quality of output for these printers.

Enhanced Mobile Computing

OS/2 Warp has new and enhanced features to address the mobile computing environment and its unique characteristics.

Plug and Play for PCMCIA

Plug and Play lets you add and remove Personal Computer Memory Card International Association (PCMCIA) devices without powering down or rebooting your system (see Figure 8). For example, you may have a Token-Ring adapter installed in your PCMCIA slot, but now you want to dial up a bulletin board system (BBS). You can remove the Token-Ring adapter and install your PCMCIA modem; the system automatically removes the Token-Ring adapter from the configuration and recognizes and configures the newly inserted modem.

You can also specify a program to run when a particular device is inserted. Continuing with our example, you can configure your system to automatically

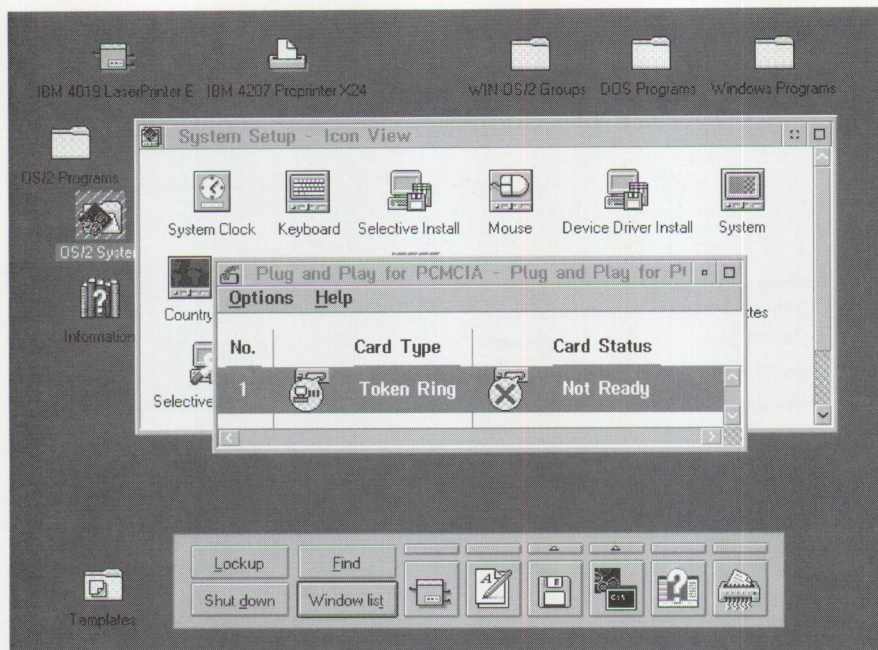


Figure 8. Plug and Play for PCMCIA

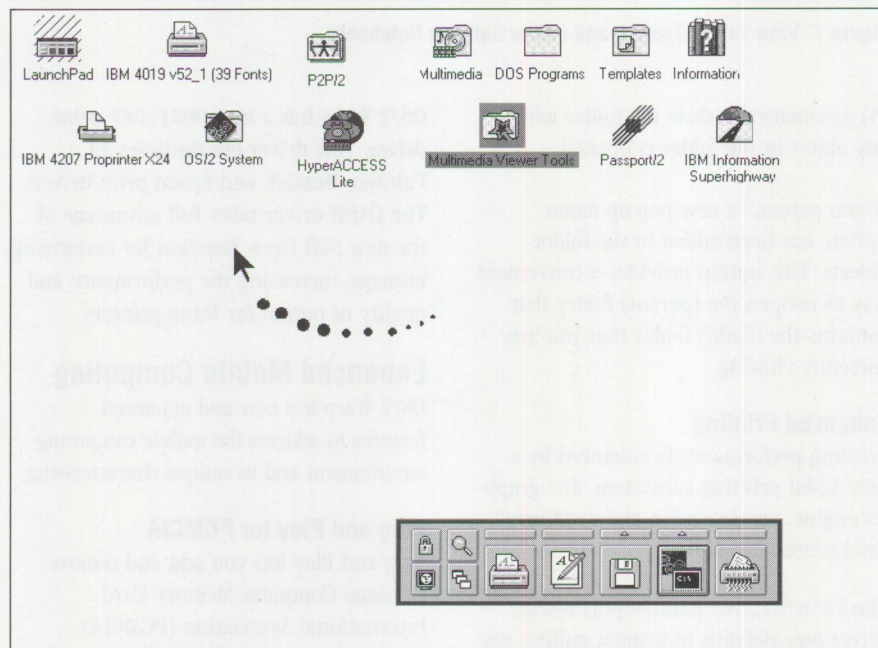


Figure 9. Comet Cursor

start HyperACCESS communications software when you install your modem.

Comet Cursor

Another new feature addresses a problem experienced by users of laptop computers with liquid crystal display (LCD) screens—losing the mouse pointer. To address this problem, OS/2 Warp not only lets you change your mouse pointer to something bigger or more visible but also provides a comet cursor. The comet cursor gives your mouse pointer a customizable tail, as

shown in Figure 9. As you move your mouse pointer across your Desktop, a tail follows the pointer, making it very visible.

Increased Hardware Support

OS/2 Warp now ships with drivers for more than 80 different video cards, including many popular video accelerator cards. You can change the resolution of these video-accelerated drivers by using the Screen tab of the System Settings notebook. For existing non-accelerated

drivers, you must use Selective Install to change resolutions. OS/2 Warp has enhanced support for CD-ROM drives, including proprietary, small computer systems interface (SCSI), and ATA Packet Interface (ATAPI) drives.

New DOS/Windows Settings

OS/2 Warp has several new DOS/Windows settings.

`Touch_Exclusive_Access` is a dynamic setting that enables a DOS window session to detect your position anywhere on the screen. Turn this setting on when a touch application is not responding properly.

The new `WIN_ATM` setting loads ATM 2.5 font support when a Windows session is started. If you don't need this support, it is best to turn it off and conserve the memory.

`Session_Priority` has been added for DOS sessions. This priority can be helpful when trying to run timing-critical programs such as communications programs. The default `Session_Priority` value is 1, with a maximum value of 32. All DOS sessions run in a regular class priority, and a setting of 32 is the highest priority within the regular class.

OS/2 Warp can save and load the DOS and Windows settings to or from an encoded file. (The file is actually an ASCII file that is encoded with variables that represent the DOS/Windows settings and the value to which each of the settings should be set.) Saving the settings makes it easier to troubleshoot a user's problem, because the user can save his/her settings and send you that file. You can then load the file onto your system, knowing that you have the same settings as the user. If your settings are set correctly for a particular DOS or Windows application, you can use the load feature to easily propagate those settings to another computer.

Enhanced Windows Support

Windows support has been extended to include Windows 3.11, Windows for Workgroups, and Win32s 1.1 support. Peer-to-peer services in Windows for Workgroups and VxD services are not supported.

Performance of Windows sessions in OS/2 Warp has been enhanced by optimizing the kernel and memory allocation. OS/2 Warp now supports popular audio cards in the Windows sessions. This allows you to run your Windows sound-enabled applications under OS/2.

Online Documentation

OS/2 Warp comes with several information (INF) files that tell you how to get the most from your system. These files include Application Considerations, Command Reference, Multimedia, Performance Considerations, Printing in OS/2, REXX Information, and Windows Programs in OS/2. These files are located in the Information folder, which also contains the Master Help Index and the Glossary.

OS/2 Warp BonusPak

Previous versions of OS/2 contained small applications (called applets) in the Productivity folder. These "no frills" charting, database, and spreadsheet applications let you do the basics. Most of the applications previously found in the Productivity folder have been replaced in OS/2 Warp by a much more robust set of applications known as the BonusPak.

The BonusPak is a collection of productivity and connectivity applications that can provide you with everything you need to use your system immediately. This value-packed suite of applications includes standard business applications, state-of-the-art multimedia capabilities, and connection capability to the information superhighway. Let's look at what is included in the OS/2 Warp BonusPak.

IBM Works

Designed to meet the needs of a wide variety of users, IBM Works includes a set of productivity tools and application programs that can benefit corporate and home users alike. IBM Works includes:

- A full-function word processor with many advanced features like merge printing, table support, and graphics support, as well as most functions found in full, commercial word processors.
- A full-function spreadsheet with features that can address many types of applications. The Chart application takes the numbers in the spreadsheet and produces a variety of charts that

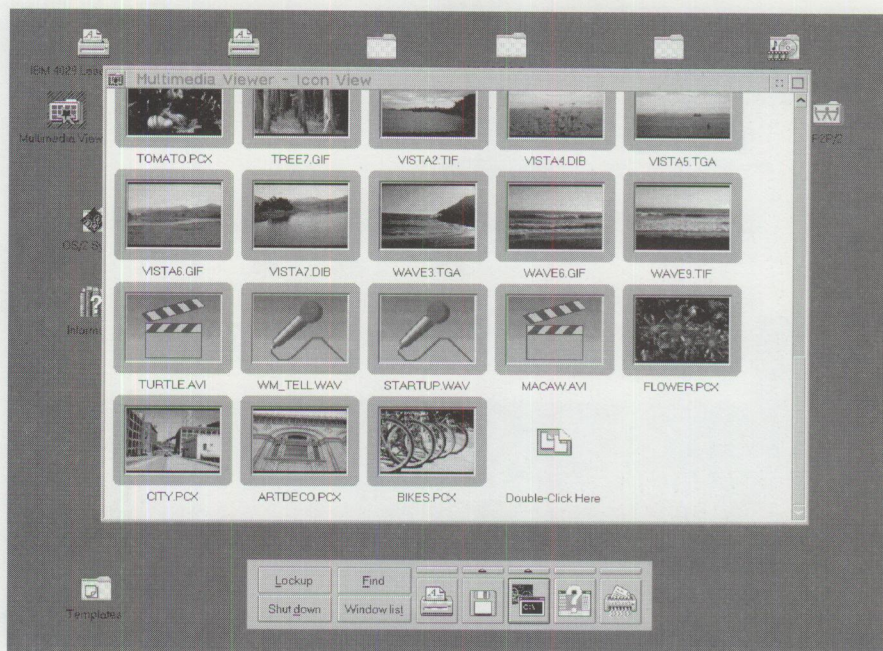


Figure 10. Multimedia Viewer

can be printed alone or integrated into other IBM Works documents.

- IBM Works' powerful database can organize both text and graphical information. The database can also import and export information in several different formats.
- IBM Works' Report Writer produces customized reports from the IBM Works database as well as from dBASE-compatible databases.
- For managing your time, the IBM Works Personal Information Manager (PIM) includes features like an appointment book, monthly planner, calendar, to-do list, phone and address book, contact list, notepad, and an event monitor with alarm.
- To address your communications needs, IBM Works includes two types of communications applications:
 - FaxWorks for OS/2 allows you to create faxes by printing from OS/2, DOS, and Windows applications. This 32-bit fax software sends and receives faxes of unlimited length and prints faxes on any OS/2 printer. Other features include viewing faxes via drag-and-drop and printing in a variety of resolutions and orientations.
 - HyperACCESS Lite is an easy-to-use, object-oriented, 32-bit communications program that you can use to

operate your modem and connect to other PCs, BBSs, and more.

As you can see, IBM Works offers a wide array of function-rich applications that you can use to get organized and productive right away.

Person to Person for OS/2

IBM Person to Person for OS/2 (P2P) provides a way for users at up to six different workstations, located in different places, to collaborate. Essentially, this application enables desktop conferencing. All participating workstations are linked via a data link (modem, LAN, ISDN, or Internet), and data is placed in a shared clipboard that can be modified in real time. Participants can also converse via phone if they have a separate phone line or correspond via the keyboard in a "chat" mode and send data between the systems. With P2P, you can work together without being together.

CompuServe Information Manager

Included in the OS/2 Warp BonusPak is CompuServe Information Manager (CIM), an object-oriented user interface for CompuServe. This quick, easy-to-use front end allows you to access, sort, and utilize the online information and services efficiently, getting the most out of your CompuServe connection.

SysInfo

OS/2 Warp BonusPak includes a Presentation Manager application that

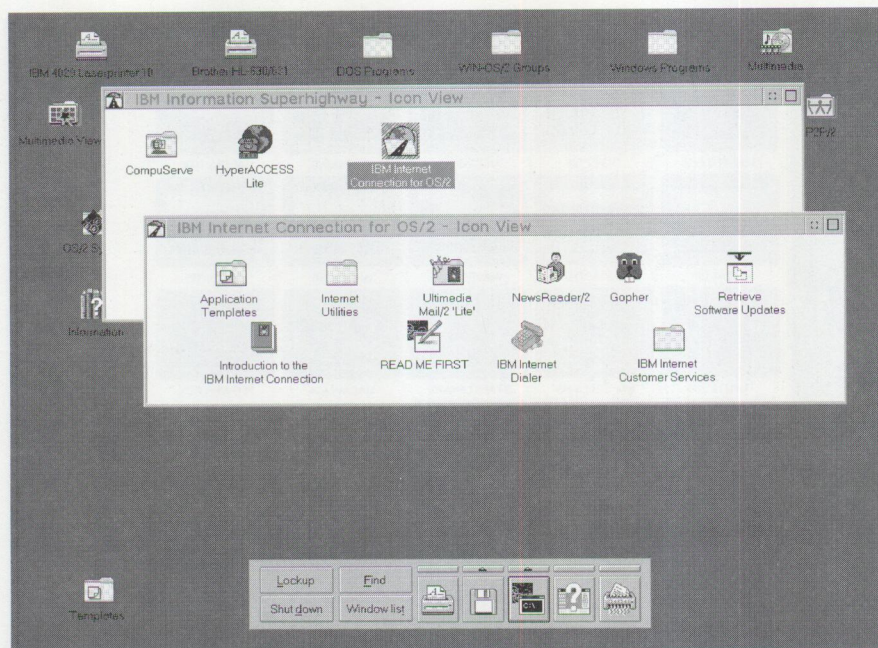


Figure 11. The Internet Connection for OS/2

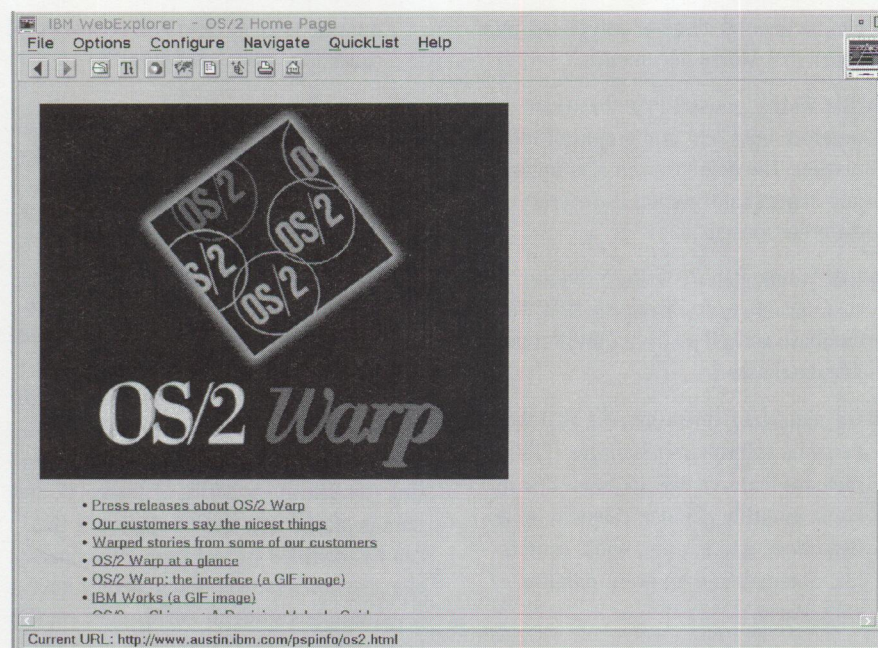


Figure 12. WebExplorer (Multimedia Front End for Internet)

gathers and displays your system's hardware and software configurations. SysInfo was designed primarily for use on IBM systems, but many features will work on other manufacturers' systems. The information gathered can be saved in a file or viewed online.

Multimedia Viewer

IBM's Multimedia Viewer (see Figure 10) is an object-oriented tool that organizes and manages your multimedia audio, video, and image files. Multimedia Viewer

displays thumbnails—miniature pictures of files—making it very easy to identify the contents of a file. Multimedia Viewer can associate programs to process the files. By double-clicking on the thumbnail frame, you can use these associated programs to play audio, view an image, or play a video segment directly from the thumbnail.

Video IN

With OS/2 Warp, you can capture digital video and compress the data into files on your hard-disk drive. Video IN supports

both IBM's Ultimotion and Indeo AVI (audio visual interactive) formats for storing video files. These files can then be played back on your OS/2 Warp system.

Internet Connection for OS/2

The Internet Connection for OS/2 is a complete software package that gives you access to the Internet's vast resources (see Figure 11). Its easy-to-use, "one-button" registration with Advantis will get you connected and online quickly. Also supported are other Internet providers that support a Single-Line Interface Protocol (SLIP) connection.

The IBM Internet Connection consists of several applications to put you on the information superhighway:

- **Ultimail Lite** provides an easy-to-use electronic mail application. Ultimail Lite supports the Multipurpose Internet Mail Extension (MIME) protocol, which enables multimedia mail such as video and audio clips.
- The **Internet Connection Gopher Client** provides a Presentation Manager-based graphical interface to Internet gopher servers. Gopher enables you to locate, display, and download files to or from the Internet.
- If there is a system on the Internet that you would like to access via a terminal emulator, **TelnetPM** will allow you to log on as a VT100, VT220, or ANSI terminal.
- **PMANT** is a Presentation Manager application that supports 3270 terminal emulation for accessing an Internet host.
- If you would like to upload or download files from the Internet, **FTPPM** provides a Presentation Manager application that supports the File Transfer Protocol (FTP).
- There are many forums or newsgroups on the Internet where you may want to exchange ideas. With **NewsReader/2**, you can access newsgroups and post items.
- One of the most exciting applications included with the IBM Internet Connection is the **WebExplorer** (see Figure 12). WebExplorer is a World Wide Web browser that gives you an easy-to-use, point-and-click, multimedia navigational tool for accessing the vast resources of the Internet.

The World Wide Web is officially described as a "wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents." It means that, by using a Web browser like WebExplorer, you have a consistent means to access a variety of files using a variety of protocols.

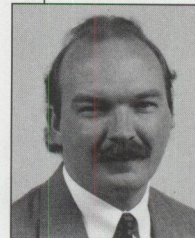
A New Level of Excitement

OS/2 Warp Version 3 brings OS/2 to a new level—a very full-function,

exciting, mature, and stable 32-bit operating system that is available for you to take advantage of today. With its full operating system and its complete set of applications, OS/2 Warp Version 3 is an incredible value.

For more information about OS/2 Warp, contact your IBM representative, connect to the IBM Personal Software Home Page on the Internet at

<http://www.austin.ibm.com/pspinfo/>, or call (800) 992-4777.



Edward Duhe is a marketing support representative in the IBM Personal Systems Competency Center in Roanoke, Texas. He provides technical support for LAN Distance and

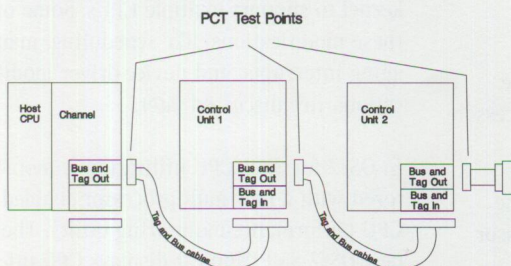
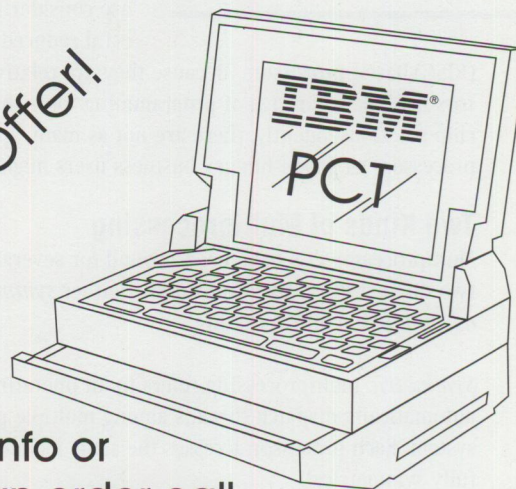
OS/2. Edward joined IBM in 1987 as a systems engineer in South Louisiana. He has a BS degree in Business Administration from Louisiana State University and can be reached via Internet at eduhe@vnet.ibm.com.

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OS/2 for SMP

This article discusses the features of OS/2 for SMP, the OS/2 version specifically designed for symmetric multiprocessing computers. It highlights the technical design of SMP and outlines the many advantages of using this new operating system in a multitude of environments.

OS/2 for SMP, which became available in July 1994, brings the power of symmetric multiprocessing to your DOS, Windows, and OS/2 applications. OS/2 for SMP protects your investment in your current application programs by providing immediate performance gains to your DOS and Windows applications and even greater performance gains to your multithreaded OS/2-based programs.

DOS and Windows programs run faster under OS/2 for SMP, because each program running in a separate virtual DOS machine (VDM) session is handled as a separate, single thread and is dispatched to the next available processor. When used for CPU-intensive applications such as database, multimedia, and scientific programs, OS/2 for SMP spreads the processor workload across multiple processors, which yields a tremendous performance increase.

Tony White
IBM Corporation
Roanoke, Texas

OS/2 for SMP solves the problems of insufficient processing power by supporting multiple 80x86 processors in a single computer. It provides relief for 80x86 users who need more processing power and who are considering a move toward more powerful reduced instruction set computer

(RISC)-based processors. Because they are relatively newer, RISC-based processors lack the full range of programming tools that are available for the 80x86 chip set. Consequently, there are not as many applications for RISC-based processors as power-hungry business users might like.

Two Kinds of Multiprocessing

Multiprocessor PCs have been around for several years and can be designed in two distinct ways: they can support either *symmetric* multiprocessing or *asymmetric* multiprocessing.

Symmetric multiprocessing refers to an operating system's ability to automatically dispatch threads among multiple processors within a single system. Each processor accesses the same memory, which makes the processor fully symmetrical.

The priority preemption scheduling policies in OS/2 for SMP are the same as in previous versions of OS/2. Now, if performance slows due to processor overutilization, simply install another processor. The workload will then be spread across one more processor, and you will see an immediate boost in performance.

OS/2 for SMP supports from one to sixteen 80486 or Pentium processors in a single computer. In addition, it supports systems that comply with the Intel Multi-Processor Specification (MPS) V1.1. Support for Intel's Advanced

Programmable Interrupt Controller (APIC) is also provided.

Asymmetric multiprocessing means that a specific task can be dedicated to a particular processor. For example, file input/output (I/O) may be assigned to one processor, communications to another, and graphics to yet another. IBM's PS/2 Server 295, when configured with multiple CPUs, is an asymmetric system. When running OS/2 LAN Server 3.0 or later, the PS/2 Server 295 runs HPFS386 on one processor while the other processor runs the operating system and applications.

Bus masters are another form of asymmetric multiprocessing. A bus master is an adapter card that has its own built-in microprocessor.

Memory utilization in an asymmetric environment differs from that in a symmetric environment in that each processor must reserve a unique part of memory for programs and tasks being processed on that CPU. The programs and tasks must use the memory that is assigned to their processor.

How OS/2 for SMP Differs from OS/2 2.11

OS/2 for SMP was designed on the OS/2 2.11 code base. It is essentially the same operating system, but with a modified kernel to support multiple CPUs. Some of these modifications, like scheduling, managing interrupts, and device-driver modifications, are discussed later.

In OS/2 for SMP, CPU utilization is monitored with a new multiprocessor-enabled CPU performance-monitoring utility. The new OS/2 SMP Monitor displays CPU utilization for each processor in bar-graph or histogram formats. It also enables you to dynamically turn processors on and off (see Figure 1). This feature is particularly useful while debugging and for measuring performance scalability with various

numbers of CPUs. The Monitor utility is located in the Productivity folder. There are no other changes or additions to icons, folders, or any other objects.

Performance Improvements

CPU power increases each time an additional processor is installed in the computer; however, CPU performance does not increase by 100% with each additional processor. Disk drives, video, and other hardware components do not run any faster. Thus, actions that require writing to the disk or updating the screen operate at the same speed as before.

Depending on the types of applications running, you can expect between a 30% and 90% improvement per additional processor. For example, in a four-processor configuration, a CPU-intensive application may see as much as a 300% performance improvement, whereas a more disk-intensive application may see "only" a 200% improvement. These numbers work out to be improvements of 75% per processor for the CPU-intensive application and 50% per processor for the disk-intensive program.

Processor Caches

Beyond its increased raw CPU power, SMP has other attractive benefits. *Caching* is a technique that is employed in both hardware and software to increase performance. Symmetric multiprocessors dramatically increase the effectiveness of the various caches.

Each 80386-or-higher processor has a Translation Lookaside Buffer (TLB), which is a hardware cache that contains information for translating virtual storage addresses to real storage addresses. (Virtual addresses must be translated into real addresses in order to process data in the system's memory.) The TLB of these processors keeps the most recent page translation addresses in cache, so that every time the processor needs to translate a linear address into a physical address, it does not have to access the Page Directory and Page Table, which reside in much slower memory.

Because this cache is small, the more unique entries it encounters, the less effective it is. A single-threaded application makes use of only one TLB and often causes thrashing within the TLB.

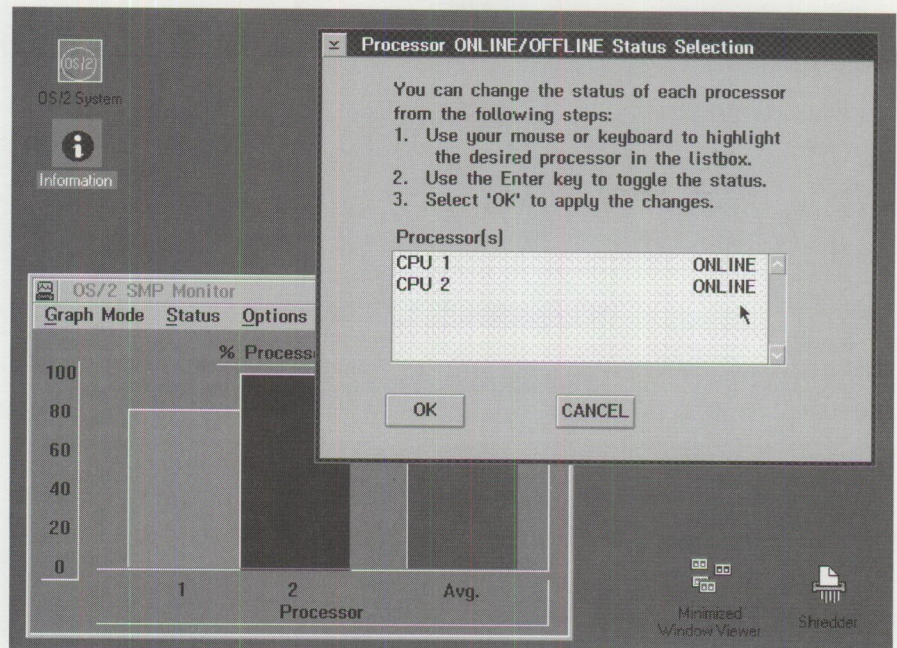


Figure 1. Dynamically Turning Processors On and Off

However, with multiple processors, each CPU has its own TLB, so multithreaded applications will make use of n TLBs (where n is the number of threads and processors available).

In addition to the TLB cache, these processors contain Level 1 (L1) caches and even Level 2 (L2) caches. The same advantages are applicable here, but to a greater degree.

Monitoring Tools

The Pegasus Resource Monitor for SMP from On Demand Software & Services, Inc. is currently the only tool available for monitoring the performance of a system running OS/2 for SMP. The Pegasus Resource Monitor for SMP monitors and graphs critical system resources such as processor CPU utilization, memory utilization, and swap information. It also records working-set data, displays thread details, and has process-kill capabilities. The data collected by Pegasus can be exported to database and spreadsheet applications for further analysis.

The Pegasus Tools package, which comes bundled with Pegasus Resource Monitor for SMP, is a very useful set of post-processing utilities. These utilities provide an easy-to-use interface for analyzing the data collected during monitoring.

Figure 2 shows Pegasus monitoring system activity, application activity, and disk I/O. The system activity session provides a global view of each CPU's activity, swap information, cache, and RAM utilization. The application activity session shows all the processes running on the CPU, as well as the threads that make up those processes. If, for example, you select the QUERYMRG.EXE process (which is using 16% of the CPU), it will display its three threads and show how much CPU utilization each thread uses. Finally, the I/O activity session shows disk utilization for all your hard-disk drives.

Software Performance

DOS, Windows, and OS/2 applications perform better in an SMP environment than in a single-processor environment. OS/2 for SMP allocates all jobs—whether DOS, Windows, or OS/2—to the next available processor, with the least-burdened processor always getting the next job. Therefore, the poorest DOS program gets as much benefit from multiprocessing as any single-threaded OS/2 program gets, although neither one benefits nearly as much as a heavily multithreaded OS/2 program.

Multithreaded applications speed up the most under OS/2 for SMP. The kernel automatically dispatches multiple threads to all the available processors. Thus, just as 10 single-threaded programs can be sent to 10 different processors (or divided

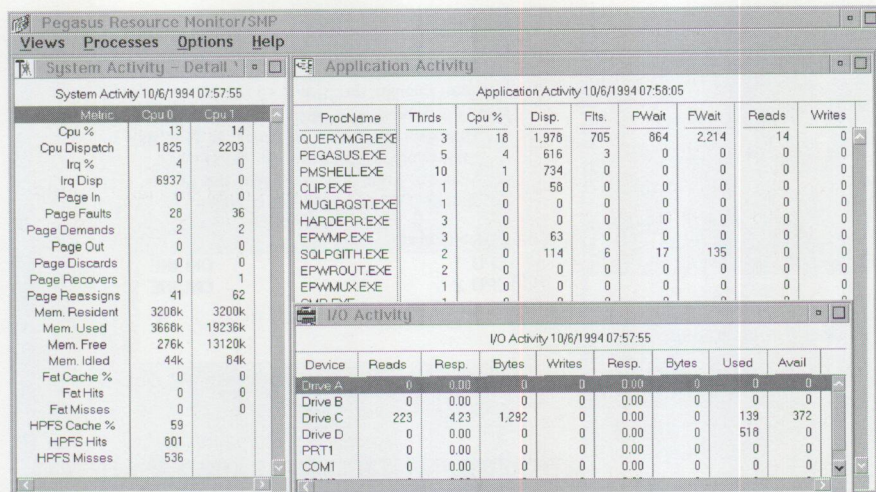


Figure 2. Pegasus Resource Monitor

among however many there are), one program with 10 threads will be "spread" across those same 10 processors, producing many times the performance of running the same application on a single-processor system. While a single-threaded program is limited to 100% of one processor, a multithreaded program might use (for example) 30% of each processor, accessing far more total CPU cycles than a single processor could provide.

CPU-intensive applications such as database, multimedia, and enhanced graphics programs will benefit the most by running on SMP systems. These programs, which use many CPU cycles, are typically at the mercy of the processor in single-processor systems—the processor generally tends to be the bottleneck. With multiple processors, the processor bottleneck is easily relieved, allowing the program to run more quickly.

Some programs are being developed specifically for SMP environments. Novell has announced a version of NetWare called Multiprocessor NetWare, to be released by mid-1995. This NetWare release will allow servers to run multiple NetWare Loadable Modules (NLMs) without becoming overburdened.

Internal Functions

Internal functions discussed below include the scheduler, spinlocks, interrupt-handling, the platform-specific drivers layer, and kernel debugger.

Scheduler

The *scheduler* is the part of the operating system that schedules, initiates, and

terminates jobs while maintaining priority preemption across all processors. It accomplishes this by using a routine that is called every time a new thread enters the ready-to-run list. The new ready-to-run candidate's priority is compared to the priority of the threads running in each processor. When the new candidate has higher priority than the thread in another processor, the scheduler interrupts the lower-priority thread, and the new candidate is dispatched to that processor.

Interrupts are also generated when a thread's time slice is exhausted. Each thread is given a predetermined time slice by the scheduler. When the currently executing thread on a given processor exhausts its time slice, it is interrupted if there are other ready-to-run threads at the same priority. When interrupted, the current thread is moved from the running state to the back of the ready-to-run chain. The scheduler then selects another thread of the same priority from the front of the chain to be run on the next available processor.

Spinlocks

Spinlocks are implemented by the kernel to protect critical resources from simultaneous access by more than one CPU. A spinlock is allocated for each critical CPU resource. When a process needs to access one of these resources, the device driver requesting the resource must "lock" itself to that device. If the resource is already locked by another process, it will "spin," waiting for the lock to become available. Once the spinlock is acquired (locked), the device driver has exclusive access to that

resource. When done with the resource, the spinlock is released (unlocked).

Spinlocks provide serial access to an exclusive resource for a very short period of time. Spinlocks have several characteristics:

- They do not replace semaphores.
- They cannot yield the CPU or issue application program interfaces (APIs).
- Page faults will release the spinlock.
- Subsystems and device drivers using new API/DevHLPs can create, acquire, release, and free spinlocks to properly serialize their resources.
- Spinlocks are used only with 16-bit subsystems and device drivers, not with 32-bit applications.
- The kernel itself uses spinlocks internally, for example, when scheduling priority queues.

Interrupt Handling

Multiprocessor hardware interrupt policies are determined by the various hardware vendors. Some vendors make the first configured processor handle all interrupt routing. This asymmetric design gives multiprocessor systems the advantage of being compatible with all of the uniprocessor device drivers.

Other vendors may use a static interrupt distribution method, which allows specific interrupts to be assigned to particular processors. For example, processor 1 could process interrupts 1, 3, 5, 7, and 9, while processor 2 processes interrupts 2, 4, 6, 8, and 10. This method has two advantages: (1) since there is no relationship between the interrupts on processor 1 and processor 2, both CPUs can process interrupts simultaneously; and (2) since a device driver can be assigned only one interrupt from one processor, compatibility is maintained with existing device drivers.

PSD Layer

Platform-specific drivers (PSDs) are used to isolate the multiprocessor architectural differences into a common interface, separate from the kernel. These drivers provide an abstract layer between the kernel and the hardware, allowing OS/2 to perform specific operations without concern for the underlying hardware implementation. PSDs enable the support of new

hardware platforms without having to modify the operating system.

PSDs are specified in the CONFIG.SYS file and must conform to the 8.3 file-naming convention (e.g., PSD=PROLIANT.PSD). They cannot contain path information, because they are processed early in the startup sequence, before the path information has been processed.

If multiple PSD statements are encountered, OS/2 loads each PSD in the order listed in the CONFIG.SYS file. The first PSD to successfully install will be the one that OS/2 uses.

Kernel Debugger

The debugger informs you about the state of all the processors, whether they are still processing code or are idle. All kernel debugger commands work as before, although a few were modified for multi-processor-specific information, and a few new ones were added.

The new and changed commands follow:

- The .DP (display processor status) command has been added. This command dumps the processor control blocks. It uses the following arguments:

* —Real current slot
—Currently selected slot
n —Designated processor's number

For example, .DP 3 displays the processor status for processor 3. When this field is left blank, the processor status for all the processors is displayed.

- The .DL (display processor spinlocks) command has been added. This command displays all the spinlocks owned by a particular processor. It uses the same arguments as the .PS command.

For example, .DL 3 displays all the processor spinlocks owned by processor 3. When this field is left blank, the spinlocks for all the processors are displayed.

The kernel debugger is designed so that only one thread can be in the debugger at any given time; therefore, the kernel debugger component uses a spinlock to serialize its access.

- The R and .R register commands have been modified to indicate which processor is running the currently selected slot. The p=xyy statement has been

added to the end of the third register line to provide this information. xx is a reference to the processor; for example, p=00 indicates that the currently selected slot is running on processor 0, while p=01 indicates that the currently selected slot is running on processor 1. The yy flags can be an s, meaning that the processor is currently spinning, and/or an r, meaning that the processor is attempting to grab one of the kernel suspend locks.

- The .SS (change current slot) command has been modified to allow you to change the processor save area (PSA) that you want to view. The .SS command is identical to the .S command. When you change to a slot that is currently running on a different processor and you dump a variable in the PSA, it will display the value of that variable on that particular processor.

Hardware Requirements

The minimum hardware configuration needed to run OS/2 for SMP is a system unit with two to 16 processors, at least 42 MB of free disk space, a CD-ROM drive, and a minimum of 6 MB of memory. While not required, it is recommended that you have at least 8 MB of memory.

OS/2 for SMP currently runs only on the computer systems listed in Figure 3.

Advance Logic Research (ALR)
ProVEISA SMP

AST Research Manhattan SMP

Compaq: Proliant
Proliant 2000
Proliant 4000
System Pro

Hewlett Packard NetServer 5/66 LM2

Tricord System PowerFrame Model 30

Vtech Platinum SMP

Wyse Technology Series 7000i
Model 760

Figure 3. Computer Systems That Support OS/2 for SMP

Software Prerequisites

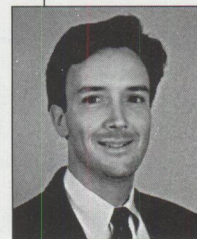
If you want to run IBM LAN Server, DATABASE 2 OS/2 (DB2/2), Communications Manager/2 (CM/2), or Network Transport Services/2 (NTS/2), the prerequisites listed in Figure 4 must be applied. These fixes can be obtained by calling (800) 992-4777.

Acknowledgment

I would like to acknowledge the help of Jim Macon, lead developer of OS/2 for SMP, in preparing this article, particularly the Kernel Debugger section.

LAN Server 3.01			
LS	APAR	IC07607	
NTS/2	APAR	IC07151	
LAN Server 3.00			
LS	CSD	IP07045	
LS	APAR	IC07607	
NTS/2	APAR	IC07151	
CM/2 1.10			
CM/2	CSD	WR06150	
NTS/2	APAR	IC07151	
NTS/2 1.0			
NTS/2	CSD	WR07045	
NTS/2	APAR	IC07151	
DB2/2 1.2			
DB2/2	APAR	JR08083	
NTS/2	APAR	IC07151	
<i>Note:</i> CICS currently does not work with SMP.			

Figure 4. Software Prerequisites



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for consulting services engagements, particularly in the area of OS/2 performance tuning. His prior assignments (in Houston) included marketing branch office administration, customer engineering, and marketing systems engineering. Tony has a BS degree in Environmental Science from McNeese State University at Lake Charles, Louisiana. His Internet userid is t_white@vnet.ibm.com.

Multimedia File I/O Services

This article explains Multimedia I/O Services (MMIO) functions in detail, as well as MMIO differences between the Windows Multimedia Extension (MME) and the OS/2 Multimedia Presentation Manager/2 (MMPM/2) subsystem.

The trend for people to use multimedia—text, graphics, video, image, animation, and sound—in their daily work is growing. These days, a personal computer can become a musical instrument, a CD player, a television, a movie recorder and player, and so on. Any home electronics equipment that you can imagine will eventually be integrated into the personal computer.

To expedite the development of multimedia applications, IBM and Microsoft have established an industry-standard interface for OS/2 2.x and Windows 3.x, respectively. This interface addresses two key areas: Media Control Interface (MCI), which provides the conceptual model for implementing logical devices such as players and recorders; and Multimedia File I/O Services (MMIO), which supports access to files. Figure 1 depicts the overall multimedia system architecture and the relationship between the MCI and MMIO components.

RIFF File Format

Since the beginning of the computer era, file input/output (I/O) has played a key role in software systems. Unfortunately, over the years, hundreds of file formats have been defined, for example, PCX, TIFF, MODCA, VOC, and AVSS. This creates a data-exchange problem, because a file format produced by one software product may not be usable by another product.

Fetchi Chen and Dan Dorrance
IBM Corporation
Boca Raton, Florida

To reduce the development overhead necessary to support all of the various file formats, Microsoft proposed a standard file format for multimedia: Resource Interchange File Format (RIFF). The concept of the RIFF file is borrowed from the

Electronic Arts IFF 85 Standard for Interchange Format Files document. RIFF is very similar to the TIFF file format; both use IDs to describe data usage purposes; however, RIFF uses Chunk ID and TIFF uses Tag ID.

The RIFF file can be viewed as a chunk of data that contains a number of subchunks nested within more subchunks, and so on.

Figure 2 depicts a layout of the RIFF file format. In the RIFF file format, the first four bytes (ID) must be 'R', 'I', 'F', 'F'. The second four bytes (size) specify the size of Chunk 1 data. The Formtype is a four-character code (FOURCC) value identifying the data representation; for example, WAVE (Waveform Audio) or RMID (RIFF MIDI).

Chunk 2 is a list chunk that contains Chunk 3 (for example, copyright statements) and Chunk 4 (for example, description information). Chunk 5

is a data-list chunk with only one data chunk, Chunk 6, which may consist of all waveform audio samples for the file.

Note that Chunk 1 is in level 0, Chunks 2 and 5 are in level 1, and Chunks 3, 4, and 6 are in level 2. Position transition from the outer level (low-level chunk number) to the inner level (high-level chunk number) is called *descend*. The converse is called *ascend*.

The advantage of the tag file structure is the flexibility to add new tags while maintaining data compatibility. If the application program always processes the chunks that it recognizes and ignores the chunks it doesn't understand, data compatibility is always maintained.

In addition to the file format described above, the *Multimedia Programming Interface and Data Specifications 1.0* document issued by IBM and Microsoft in August 1991 defines the structure of a compound file. A *compound* file is a higher-level file wrapper that wraps RIFF file elements together. For example, a compound file can contain a video file element, an audio file element, an image file element, and a control-information file element, which describes how the audio, video, and image should be synchronized when they are played back. Figure 3 shows the layout of a RIFF compound file.

Multimedia File I/O Services (MMIO)

MMIO is intended to be a simple and fast, yet flexible, interface for reading, writing, and manipulating data items. Moreover, the major goal is to make it a standard interface by insulating the application from the underlying file formats and strengthening the program's portability as well as the data's compatibility. Four primary features are supported in MMIO:

- **Buffered I/O**—maintains an I/O buffer that holds data as it is read from (or written to) disk. This buffering reduces

the number of disk accesses for many small reads. The buffer can either be provided by the caller or allocated by the system.

- **RIFF file I/O**—provides simple functions that locate, create, enter, and access the RIFF chunk.
- **Memory file I/O**—looks like a file to an application. This unifies the interface for applications that access both files and memory.
- **Installable I/O procedure**—knows how to open, read, write, seek, and close the file.

The basic MMIO functions supported by both Windows and OS/2 multimedia extensions are:

- **mmioAdvance**—advances the I/O buffer of a file set up for direct I/O buffer manipulation by **mmioGetInfo**.
- **mmioAscend**—ascends out of a chunk in a RIFF file that was descended into by

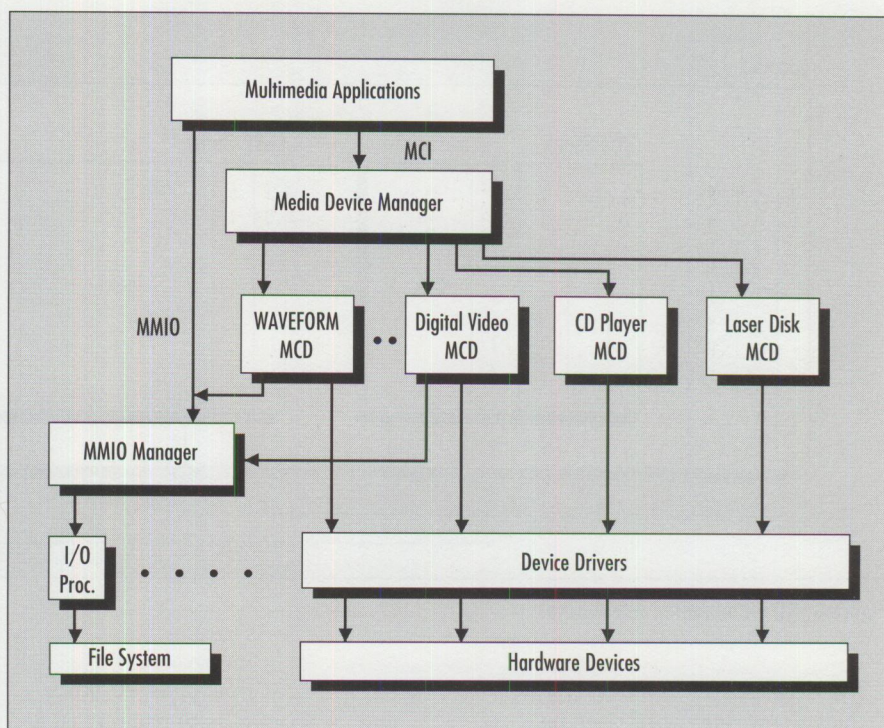


Figure 1. Multimedia System Architecture

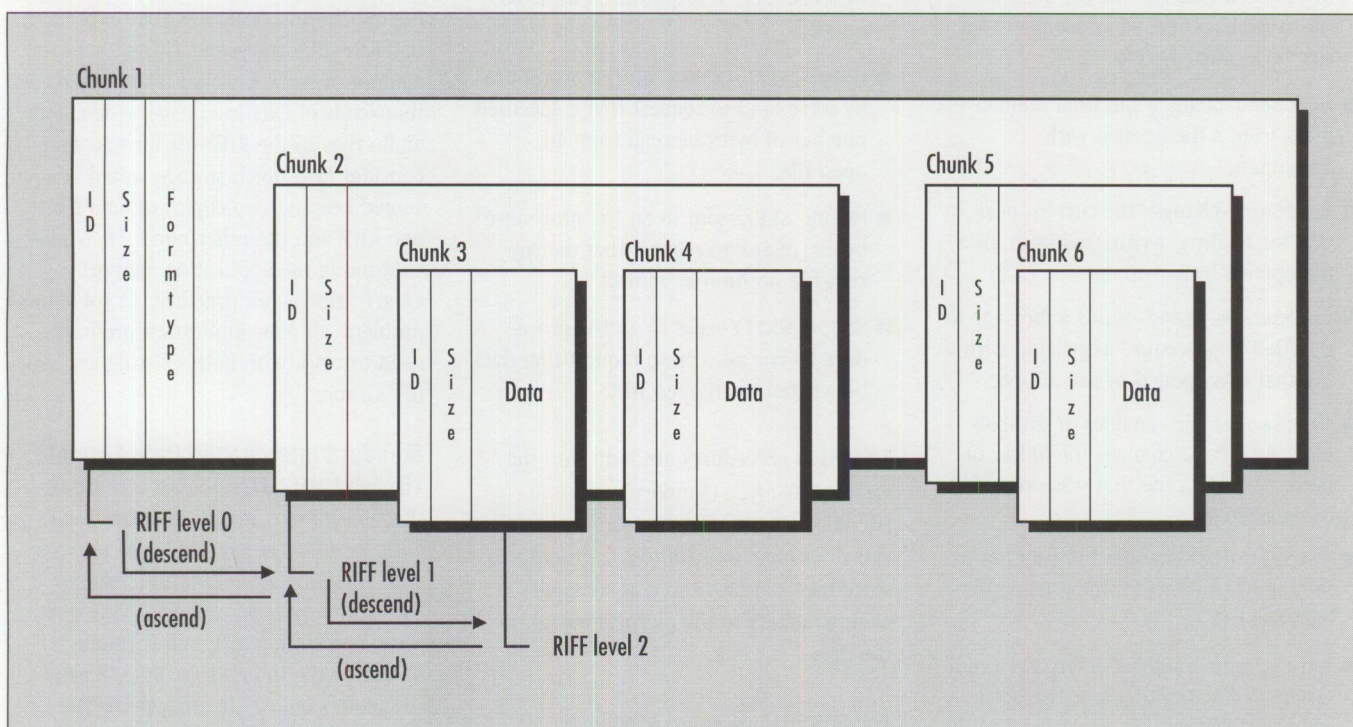


Figure 2. RIFF File Format

- **mmioDescend**—descends into a RIFF file chunk beginning at the current file position, or searches for a specified chunk.
- **mmioFlush**—writes the I/O buffer of a file to disk, if the I/O buffer has been written to.
- **mmioFOURCC**—converts four characters to a four-character code (FOURCC).
- **mmioGetInfo**—retrieves information from the file I/O buffer to a file opened for buffered I/O.
- **mmioInstallIOProc**—installs an I/O procedure in the MMIO IOProc table.
- **mmioCreateChunk**—creates a chunk in a RIFF file that was opened by **mmioOpen**.
- **mmioClose**—closes a file opened with **mmioOpen**.
- **mmioDescend** or created by **mmioCreateChunk**.

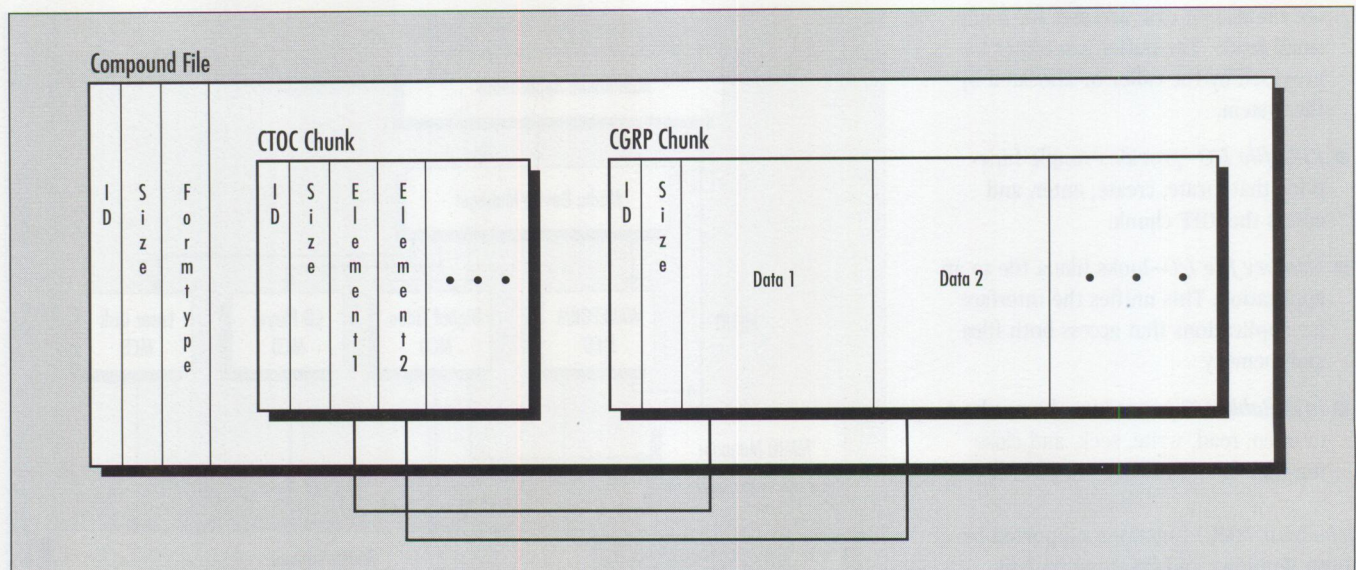


Figure 3. RIFF Compound File Format

removes an IOProc from the table, or finds a procedure when given its FOURCC identifier.

- **mmioOpen**—opens a file for unbuffered or buffered I/O. The file can be a DOS file, a memory file, or an element of a custom storage system.
- **mmioRead**—reads a specified number of bytes from a file opened with **mmioOpen**.
- **mmioSeek**—changes the current position for reading, writing, or both, in a file opened by **mmioOpen**.
- **mmioSendMessage**—sends a message to the file I/O procedure associated with a file that was opened by **mmioOpen**.
- **mmioSetBuffer**—enables or disables buffered I/O, or changes the buffer or buffer size for a file that was opened using **mmioOpen**.
- **mmioSetInfo**—changes information in the file I/O buffer of a file opened for buffered I/O.
- **mmioStringToFOURCC**—converts a null-terminated string to a four-character code (FOURCC).
- **mmioWrite**—writes to a file that was opened using **mmioOpen**.

The application program issues the above MMIO functions to the MMIO Manager. The MMIO Manager processes the functions, sends messages to the file I/O procedures if further processing is necessary, and returns results to the application programs. Following are six of the more frequently used messages:

- **MMIOM_CLOSE**—sent to an I/O procedure by **mmioClose** to request that a file be closed.
- **MMIOM_OPEN**—sent to an I/O procedure by **mmioOpen** to request that a file be opened.
- **MMIOM_READ**—sent to an I/O procedure by **mmioRead** to request that a specified number of bytes be read from an open file.
- **MMIOM_SEEK**—sent to an I/O procedure by **mmioSeek** to request that the current file position be moved.
- **MMIOM_WRITE**—sent to an I/O procedure by **mmioWrite** to request that data be written to an open file.

Three I/O procedures are built into the system: DOS, MEM (Memory), and BND (Bundle). These procedures are also called *Storage Subsystem I/O* procedures, since they can be viewed as wrappers or unwrappers to the physical layout of the files.

The DOS I/O procedure handles the regular DOS files. The MEM I/O procedure manages memory files without going through the file system. The BND I/O procedure supports a special case of the RIFF compound-file format called BUNDLE.

Figure 4 shows the relationship of the three I/O procedures and the MMIO Manager.

OS/2 Extension to Base MMIO

The beauty of base MMIO is its ability to easily support a new RIFF file format by installing a corresponding file I/O procedure. However, it does not address existing application programs that have used non-RIFF files for years. Think about the amount of work it would take to convert thousands of existing image, video, and audio files to the RIFF file format. And consider how much storage would be consumed keeping two copies of data files, one RIFF and the other non-RIFF, while continuing the application support. Clearly, this is not practical. To solve this problem, all new application programs need to work with both existing and new file formats.

Standard Interchange Data Format

The OS/2 MPM/2 solution introduces the concept of a *standard interchange data format*. The purpose is to provide a universal data-presentation level for each different type of media. This way, if the application program is coded to handle the interchange data, it can completely ignore the underlying file formats and still work successfully, provided that the installable I/O procedure supports the standard interchange data format.

For example, a PCX file doesn't have the chunk form, so if the application program uses **mmioDescendChunk** or **mmioAscendChunk** to position to header (to go to a particular location in the PCX file) to obtain file information, the

program will fail. What the application program can do is request the interchange feature at mmioOpen time, use mmioGetHeader to get the standard interchange header information, and then use mmioRead to read the standard interchange data described by the header.

Figure 5 shows the conceptual view of the standard interchange data format.

Figure 6 shows the data structure of the audio interchange header.

Image, musical instrument digital interface (MIDI), video, and movie standard headers also have been defined. For details, please refer to the *MMPM/2 Programming Reference*, part of the OS/2 2.1 Toolkit.

New MMIO Functions in MMPM/2

The OS/2 MMPM/2 product supports functions for manipulating the compound-file header. The following is the list of all new MMIO functions in OS/2 MMPM/2:

- mmioCFAddElement—adds an element to the CGRP chunk of an open RIFF compound file.
- mmioCFAddEntry—adds an entry to the CTOC chunk of an open RIFF compound file.
- mmioCFChangeEntry—changes a CTOC entry in an open RIFF compound file.
- mmioCFClose—closes a RIFF compound file that was opened by mmioCFOpen.
- mmioCFCopy—copies the CTOC and CGRP chunks from an open RIFF compound file to another RIFF compound file.
- mmioCFDeleteEntry—deletes a CTOC entry in an open RIFF compound file.
- mmioCFFindEntry—finds a CTOC entry in an open RIFF compound file.
- mmioCFGetInfo—retrieves the CTOC header of an open RIFF compound file.
- mmioCFOpen—opens a RIFF compound file by name.
- mmioCFSetInfo—modifies information that is stored in the CTOC header of an open RIFF compound file.
- mmioDetermineSSIOProc—determines the storage system of the media data object.

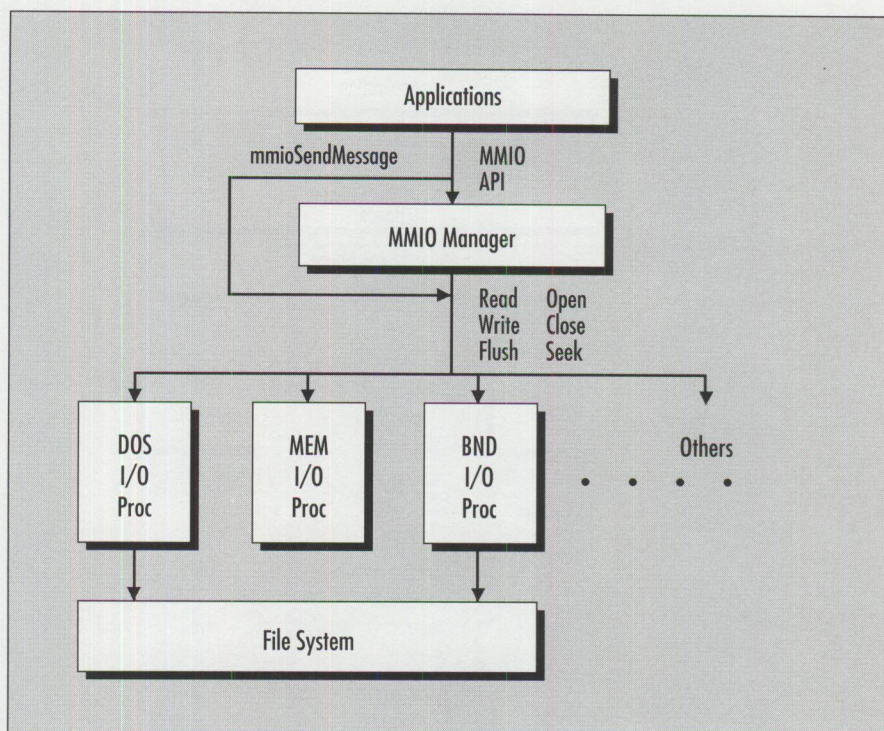


Figure 4. DOS, MEM, and BND I/O Procedures

- mmioGetFormatName—provides the descriptive name of the format supported by the IOProc.
- mmioGetFormats—provides a list of all format I/O procedures available for use.
- mmioGetHeader—obtains media-specific information about data in a file, such as the media type, media structure, and the size of the media structure.
- mmioGetLastError—returns the last error condition stored in dwErrorRet that might contain additional information for the analysis of the last error.
- mmioIdentifyFile—determines the format of a file either by using the file name or querying currently installed I/O procedures to see which IOProc can understand and process the specified file.
- mmioIdentifyStorageSystem—identifies the storage system that contains the media data object.
- mmioIniFileHandler—adds, replaces, removes, or finds an entry in the initialization file.
- mmioQueryFormatCount—provides the number of IOProcs that match the requested format.
- mmioQueryHeaderLength—determines the size of the header for a specified file.

- mmioQueryIOProcModuleHandle—provides the module handle of an IOProc's dynamic link library (DLL). This handle must be used to retrieve resources from the DLL. This function provides the handle of the DLL only if it was loaded by MMIO from the MMPMMIO.INI file.
- mmioSetHeader—sets media-specific information for data to be written to a file.

CODEC Support

Another feature of the OS/2 MMPM/2 MMIO is its CODEC (compression and decompression) support. CODEC algorithms have been widely used in the industry, especially with multimedia applications, due to limited storage and communication bandwidth. The existing CODEC algorithms are implemented as either embeds in the application program (or file I/O procedure) or as runtime libraries.

As more and more file formats and CODEC algorithms are introduced, problems in storage and maintenance appear. First, duplication of the same CODEC algorithm in different file formats causes storage waste and maintenance difficulty. Second, newly defined CODEC algorithms cannot be easily supported without modifying the application programs or file I/O procedures.

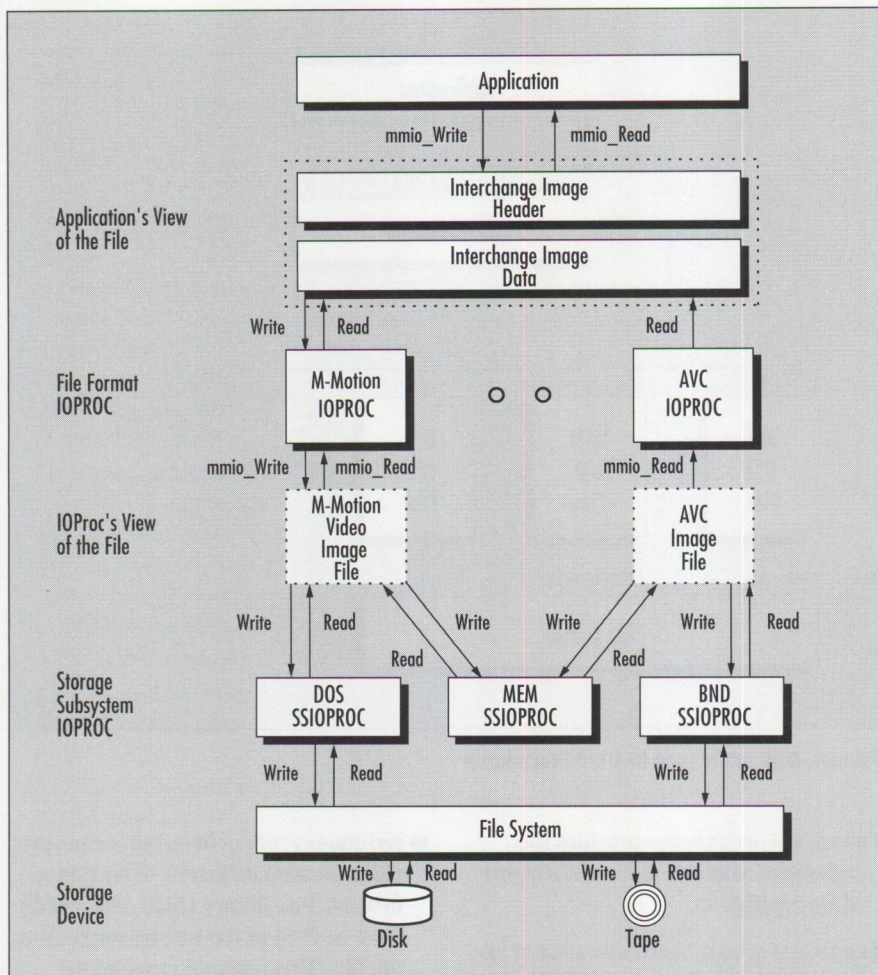


Figure 5. Conceptual View of the Standard Interchange Data Format

```
typedef struct _MMAUDIOHEADER { /* standard audio header */
    ULONG    ulHeaderLength; /* structure length */
    ULONG    ulContentType; /* voice, music, HIFI, etc. */
    ULONG    ulMediaType; /* audio */
    USHORT   usFormatTag; /* PCM, ALaw, MuLaw, etc. */
    USHORT   usChannels; /* 1 or 2 */
    ULONG    ulSamplesPerSec; /* 8 - 44 kHz */
    ULONG    ulAvgBytesPerSec; /* data transfer rate */
    USHORT   usBlockAlign; /* block alignment in bytes */

    USHORT   usBitsPerSample; /* No. of bits per sample */
    ULONG    ulAudioLengthInMS; /* total length in minisec */

    ULONG    ulAudioLengthInBytes; /* total length in bytes */
}
```

Figure 6. Data Structure of Audio Interchange Header

/* FOURCC	COMP-TYPE	COMP-SUBTYPE	DLL-NAME	PROC-NAME	CAPABILITIES */
"PCX "	1	0	RLE.DLL	RLECODEC	CAN-DECOMPRESS
"BMP "	1	0	RLE.DLL	RLECODEC	CAN-DECOMPRESS

Figure 7. CODEC Algorithm Information in System Initialization File

To solve these problems, OS/2 MMPM/2 defines an identifier to associate with a CODEC procedure. The identifier consists of a FOURCC character code, a compression type, a compression subtype, a hardware adapter name (if applicable), and some capability flags.

The FOURCC determines the file format, such as BMP or PCX. The compression type determines the compression algorithm, for example, Run-Length Encoding (RLE). The compression subtype determines additional attributes of the compression algorithm, for example, Lossless or Lossy.

The hardware adapter name identifies the hardware that executes the CODEC algorithm. The capability flags are attributes such as can-compress, can-decompress, and so on.

When a CODEC algorithm is installed in the system, the system initialization file may contain the entries shown in Figure 7. *Note:* The comment line shown in Figure 7 does not actually appear in the system initialization file; its intent is to explain the fields that do appear in the system initialization file.

Notice in Figure 7 that both entries in the initialization file contain the same CODEC DLL file name and procedure name. If the PCX or BMP file already exists on the disk, the logic flow for decompressing the file is as follows:

1. The application program issues the mmioOpen function to the MMIO Manager.
2. The file I/O procedure gets control either by the provided FOURCC or through the identification process.
3. The file I/O procedure extracts compression type and subtype (if it applies) from the file header and issues the mmioLoadCODECProc function to load the CODEC procedure.

4. The file I/O procedure sends the `MMIOM_CODEC_OPEN` message to the CODEC procedure to obtain instance data.
5. The application issues `mmioRead` to start reading uncompressed data from the file.
6. The file I/O procedure issues another `mmioRead`, this time to the Storage System I/O Procedure, to read compressed data from the file.
7. The file I/O procedure starts to decompress it by sending the `MMIOM_CODEC_DECOMPRESS` message to the CODEC procedure.
8. The file I/O procedure finishes data decompression and sends the `MMIOM_CODEC_CLOSE` message to the CODEC procedure to close the instance.

If the PCX or BMP file doesn't exist, the logic flow for creating a Run-Length-Encoded compressed data file is as follows:

1. The application program issues the `mmioOpen` function to the MMIO Manager.
2. The file I/O procedure gets control either by the provided FOURCC or through the identification process.
3. The application issues the `mmioIniFileCODEC` to enumerate all RLE CODEC procedures and locate the fastest CODEC procedure.
4. The application issues `mmioSet` to set the information for the fastest CODEC procedure.
5. The file I/O procedure gets the information and issues the `mmioLoadCODECProc` function to load the CODEC procedure.
6. The file I/O procedure sends the `MMIOM_CODEC_OPEN` message to the CODEC procedure to obtain an instance.
7. The application issues `mmioWrite` to start writing uncompressed data to the file.
8. The file I/O procedure gets data from the application and starts to compress it by sending the `MMIOM_CODEC_COMPRESS` message to the CODEC procedure.
9. The file I/O procedure issues another `mmioWrite`, this time to the Storage

System I/O Procedure, to write compressed data to the file.

10. The file I/O procedure finishes data compression and sends the `MMIOM_CODEC_CLOSE` message to the CODEC procedure to close the instance.

The MMIO CODEC services that allow the application to install and deinstall CODEC procedures, query CODEC procedure names, and load the CODEC procedures are:

- `mmioIniFileCODEC`—adds, replaces, removes, or finds a CODEC entry in the MMIO INI file.
- `mmioQueryCODECName`—returns the CODEC procedure name.
- `mmioQueryCODECNameLength`—returns the length of the CODEC procedure name.

For simplicity, this program uses the file I/O procedures provided by the system.

- `mmioLoadCODECProc`—loads the CODEC procedure and returns the entry point.
- `mmioSet`—sets or queries extended file information.

Figure 8 depicts the system architecture for the CODEC transparency.

MMIO Example

An OS/2 PM program is available on the OS/2 Bulletin Board System (OS2BBS) to show how easily the MMIO function can convert files between the OS/2 2.0 BMP image file format (which works in all OS/2 2.x versions and in OS/2 Warp) and the IBM M-MOTION image file format.

The file is called `MMIOXMP.C` and is part of a package called `MMIOXMP` located in the `OS2TOOLS` section of the Software Library on the OS2BBS.

When the program starts, two sets of pushbuttons are shown in the dialog box. The top two pushbuttons are for installing and removing the file I/O procedures at runtime execution. The button text shows the current state of the I/O

procedure. For example, "OS/2 2.0 Proc Installed" means that the OS/2 2.0 BMP file format I/O procedure is currently installed in the system. When the button is clicked, the program toggles the state by removing or installing the file I/O procedure, depending on the previous state.

Three functions are issued:

- `DosLoadModule()`—loads the file I/O procedure DLL.
- `DosQueryAddr()`—queries the entry point of the loaded I/O procedure.
- `mmioInstallIOProc`—installs the I/O procedure in the system.

For simplicity, this program uses the file I/O procedures provided by the system. You can create your own file I/O procedure DLL for your file format (for example, TIFF), and install it at runtime.

Note that another MMIO function, `mmioIniFileHandler()`, serves a similar purpose. The difference is that `mmioIniFileHandler()` only installs in the MMIO INI file. At initialization, the MMIO Manager takes a snapshot of the INI file and loads it in memory for later references. So, if a file I/O procedure is installed through `mmioIniFileHandler()`, the MMIO Manager won't be aware of it until the next initialization. For now, you need to reboot the system to reinitialize the MMIO Manager.

The two pushbuttons at the bottom of the dialog box are for the file format conversion. One push button converts the OS/2 2.0 BMP file format to the IBM M-Motion file format. The other does the opposite: When the button is clicked, a dialog box prompts you to input the source and target file names.

The file format conversion is then performed in `mmioConvertBitMap()`, as follows:

1. `mmioOpen()`—opens the source and target files.
2. `mmioGetHeader()`—is issued to get the standard image header from the source file.
3. `mmioSetHeader()`—is called to set the standard image header to the target file.

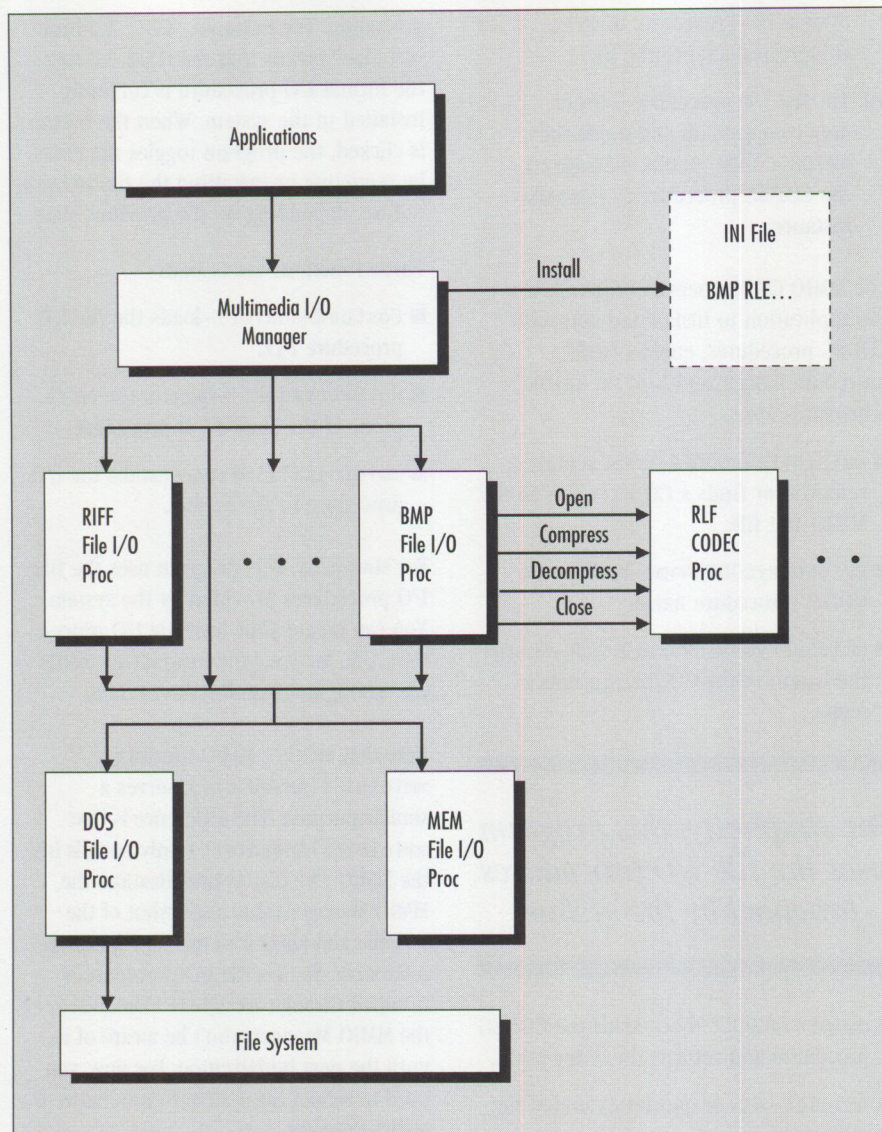


Figure 8. MMIO CODEC Architecture

4. `DosAllocMem()`—allocates the image buffer based on the image width and pixel bit count.
5. `mmioRead()`—reads the data from the source file.
6. `mmioWrite()`—writes the data to the target file.
7. `mmioClose()`—closes both source and target files.

Conclusions

As multimedia became more mainstream, IBM and Microsoft took steps to include the multimedia extension in OS/2 2.1 and Windows 3.1. This made the

Multimedia File I/O Services (MMIO) a standard interface across platforms.

The original intent of MMIO functions was to confine and support all multimedia data in the RIFF file format. With the requirements of program compatibility and portability, further work has been done in OS/2 to generalize the interface for supporting multiple file formats as well as pluggable CODECs. For example, OS/2 2.1 plays back the RIFF AVI (audio visual interactive) movie files in different encoding algorithms such as Ultimotion and Indeo. All the video data access is through the AVI file I/O procedure and CODEC procedures.

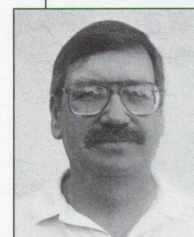
In addition, as certain formats such as Photo CD image become pervasive, they can be packaged as an I/O procedure and shipped either directly with the base product, as a separate add-on package, or placed on a BBS. IBM is encouraging third-party developers to create I/O procedures and CODECs for the OS/2 platform.

Future work can be extended to support non-multimedia data files. More standard interchange headers and data formats will need to be defined to meet all industry requirements.



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Need a Fix?

The IBM Corrective Service Facility (CSF), formerly called FixTool, is a tool to distribute and install corrective service packages. This article discusses the service call and fix processes, describes CSF's features, and explains how to use CSF when installing a ServicePak or fix.

A key component in IBM's desire to increase customer satisfaction with OS/2 is to provide timely service to customers who report problems.

When you report a defect with your OS/2 operating system, IBM responds by providing a repair, or fix, to the problem. Fixes come in a variety of formats: single fixes, FixPaks, private fixes, or ServicePaks.

A *fix* is a set of files that corrects an error in a program. Before IBM releases a fix to customers, the fix undergoes extensive testing and verification. After testing, the fixes are made available to all users experiencing that particular problem.

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IBM Service and Support, at (800) 992-4777 (to fastpath, press 1, 3, and 3), directs callers needing a particular fix to several electronic bulletin boards from which the fix can be downloaded. If the caller does not have electronic bulletin board access, IBM will mail the fix on diskette to the user.

A *FixPak* consists of files that resolve multiple errors in multiple programs. Rather than supplying individual fixes for each problem, a FixPak addresses all concerns simultaneously.

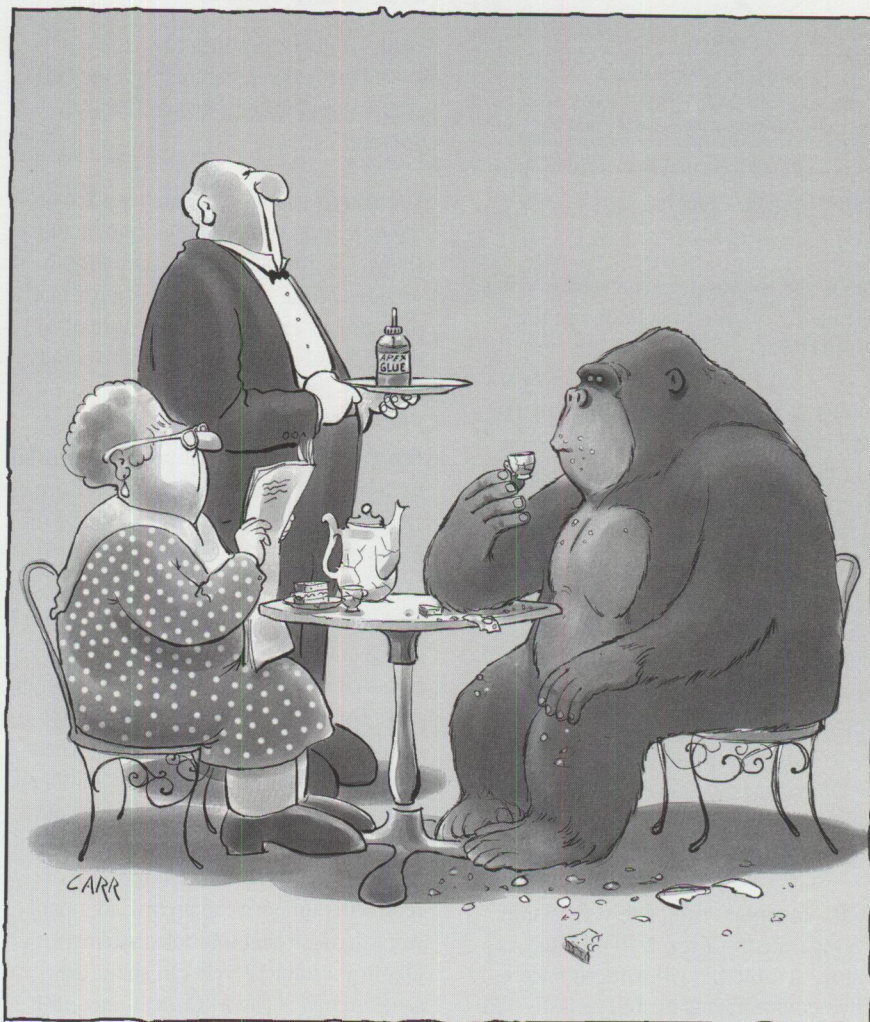
A *private fix* is shipped in only the most critical situations. It is not necessarily reproducible and does not undergo complete verification testing. As such, it is only provided to resolve critical

problems that cannot wait for complete testing and verification.

A *ServicePak* contains all the cumulative fixes developed and tested since the last product release, plus new printer and device drivers for which support is now available. A ServicePak might be released three or four months after the general availability of a new product. However, its timing can be influenced by the nature and volume of service calls.

Service Call Process

When you call IBM Service and Support to report a problem with your operating



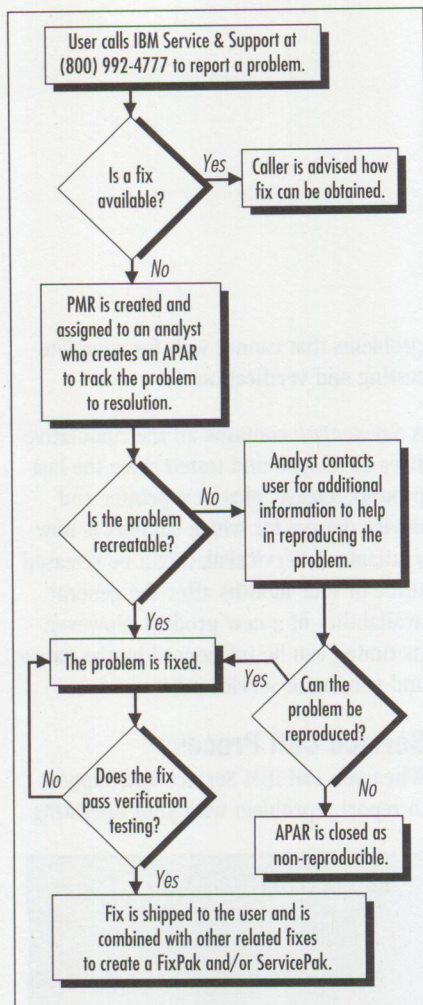


Figure 1. The Fix Process

system, the technical specialist answering the call advises you how to obtain the necessary fix.

If no fix is available for the problem, the specialist generates a Problem Management Report (PMR) that details the problem. The PMR is then assigned to an analyst for resolution.

The analyst uses the information from the PMR to recreate the problem in a controlled laboratory environment. The analyst establishes an Application Programming Analysis Report (APAR) to track his/her progress through to resolution. The analyst must be able to recreate the problem and test the fix in the laboratory before it can be verified.

The fix undergoes complete verification by a separate test organization. This ensures that the fix will work in uncontrolled environments as well as it does in the analyst's "familiar" environment. After

the fix passes verification testing, it is made available to you.

Figure 1 describes the process of creating a fix.

Corrective Service Facility

CSF is IBM's software service tool for distributing and installing ServicePaks and FixPaks shipped since April 1994.

CSF greatly simplifies the once manual, labor-intensive installation of these packages. It has an excellent graphical user interface (GUI) for manually installing service and fixes to a single system. CSF is also enabled for configuration, installation, and distribution (CID) for fast and easy installation to multiple remote systems attached to a local area network (LAN).

CSF's GUI makes service and fix installation so easy and user-friendly that it will undoubtedly encourage more OS/2 users to maintain the most current code levels on their systems.

Four Major Components

CSF's four major functional components are Service, Backout, Redirect, and Commit.

The *Service* component applies fixes to the operating system. This component allows you to specify which products or versions of the operating system (if multiple versions exist on a given system) to service. It also prompts for archive and backup paths.

The *Backout* component provides the ability to remove one fix level or to restore a system to the base (archived) level of the product.

The *Redirect* component allows you to reference an archive of the same product version that resides in a different location or drive from where your original archive resides. This is particularly useful when you want to move an archive to another logical drive that has more space available, such as a network drive or a drive with a larger partition. Another use of redirect is to move the archive to a network drive so that multiple systems with identical product levels can share the same archive. (The *ARCHIVE* function is discussed later.)

To move an archive to another location:

1. Manually create an *ARCHIVE* directory on the target partition.
2. *XCOPY* all the files from your existing archive to the new directory. *Note:* Before you *XCOPY* your archive to a LAN drive, you should contact your LAN administrator. If you use a LAN shared archive, the *XCOPY* will overwrite the previous archive.
3. Use the Redirect window of the *SERVICE* facility or the Redirect keyword of the *FSERVICE* facility to change the reference path of the old archive to the new one.
4. Erase the old *ARCHIVE* directory and all its contents.

The *Commit* component is used to free up disk space used by the *BACKUP* directory. If you are sure that you want to keep the latest ServicePak that was installed on your system and you will not have to back out to the previous code level, you can use Commit to remove all references to your archive. By using this component, you commit to use the currently installed code level. The only time you can commit to remove references to the archive is after you have applied a ServicePak.

After using Commit, you can manually delete the archive and backup files. (CSF does not delete the archive files automatically, because they can be used by multiple systems or products.)

CSF Logs

CSF maintains an inventory of all service and fixes installed on your system. The *SERVICE.LOG* file, placed in the *OS2\INSTALL* directory, contains a cumulative historical log of all service done on your system, dating all the way back to OS/2 1.0 (assuming that the hard-disk drive hasn't been erased or reformatted since then). Historically, only a ServicePak installation would update the *SERVICE.LOG*; however, in April 1994, CSF was revised so that now FixPaks as well as ServicePaks will update this file.

Prerequisite Checking

CSF does *prerequisite checking* in its installation process. Prerequisite checking ensures that fixes cannot be indiscriminately applied to systems that do not need service.

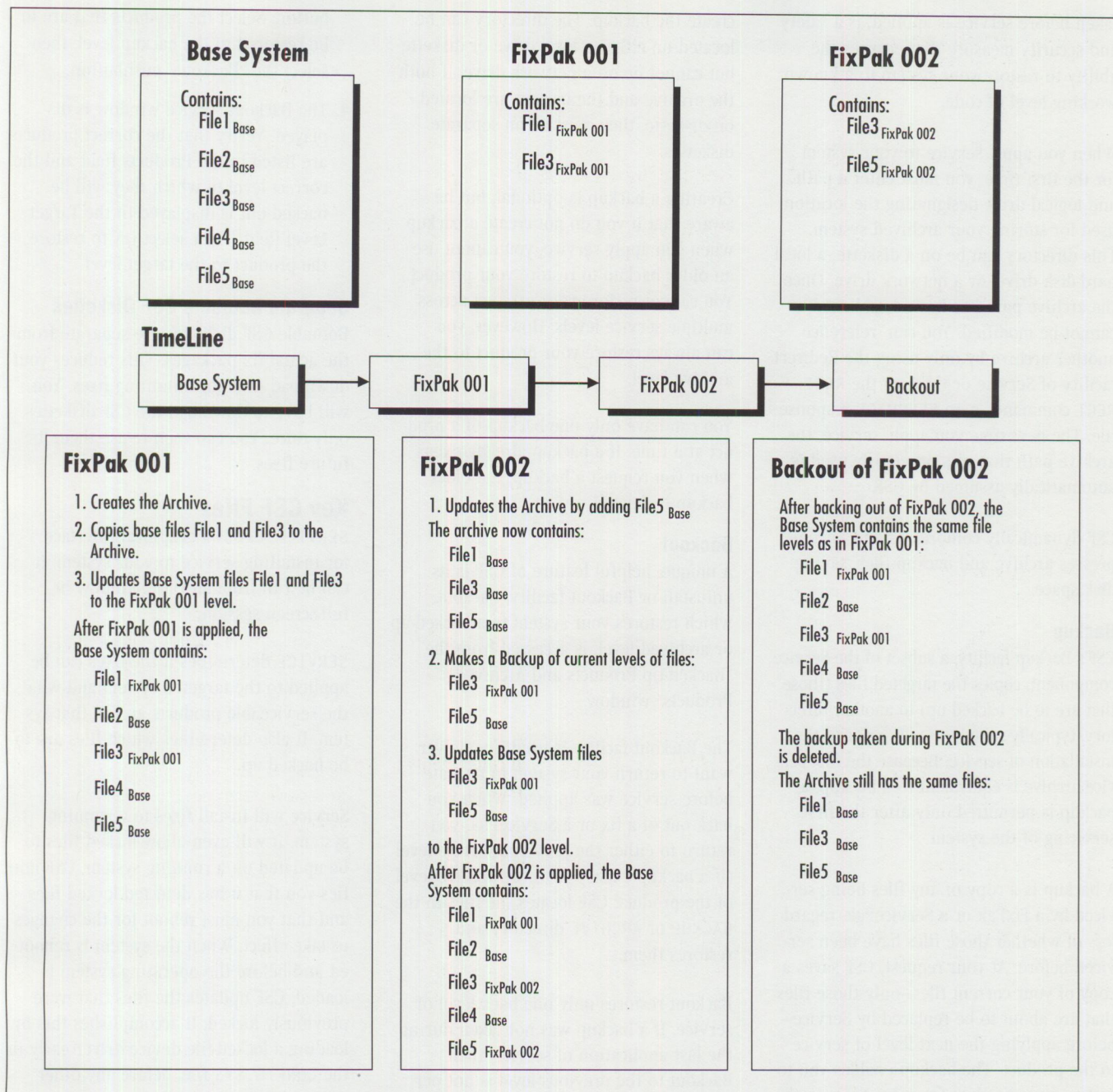


Figure 2. CSF Archive, Backup, and Backout Concepts

These checks are done by reading the SYSLEVEL.OS2 file on the targeted system. The SYSLEVEL.OS2 file keeps track of the current version of OS/2 and any optional OS/2 components installed on a system.

In SYSLEVEL.OS2, CSF checks the targeted software's country code, version, release level, edition (e.g., Standard Edition or Extended Edition), component ID, and CSD level before any fix is applied.

If prerequisite checking reveals that the installed version of OS/2 is not compatible with the fix that is about to be applied, the fix installation process halts.

If this version passes checking, a final verification is done on the actual file targeted for replacement. If the targeted file is older and differs from the file about to be installed, the installation continues and the file is replaced. However, if the targeted file is newer than the fix, the system notifies you and asks if you want to continue with the replacement. We recommend that you continue and use the

service version of the file so that your system stays at the recommended service level.

Archiving

For the following sections on archiving, backup, and backout, refer to Figure 2.

Archiving is the process of storing an OS/2 general availability (GA)-level system module in a user-specified directory and drive. A *system module* is typically a component of the operating system such as the kernel or the Workplace Shell. This archived level of code, which is

taken before service is applied, is a safety and security measure that ensures the ability to restore your system to a known, working level of code.

When you apply service to your system for the first time, you must enter a path and logical drive designating the location used for storing your archived system. This directory can be on a diskette, a local hard-disk drive, or a network drive. Once the archive path has been established, it cannot be modified. You can reference another archive by only using the Redirect facility of Service or through the REDIRECT command in an FSERVICE response file. The next time you apply service, the archive path that was previously used is automatically assumed by CSF.

CSF dynamically compresses and uncompresses archive and backup files, saving disk space.

Backup

CSF's Backup facility, a subset of the Service component, copies the targeted files (those that are to be backed up) to another directory, typically called BACKUP, prior to the installation of service. Because the first service archive is equivalent to a backup, a backup is permitted only after the first servicing of the system.

A backup is a copy of any files being serviced by a FixPak or a ServicePak, regardless of whether those files have been serviced before. At your request, CSF saves a copy of your current files—only those files that are about to be replaced by Service—before applying the next level of service to the product. The backup enables you to restore your product (at some point in the future) to its level of service before the most recent service was applied.

A backup must be done after the first service because the archive grows cumulatively. The first time that service is applied, any file that was serviced is archived. The next time that service is applied, only those files that are not already in the archive are added to it. At this point, invoking Backup will create a backup of any files that changed. If some files that changed were previously serviced, you may want to keep a newer version.

You request a backup by specifying a path and directory in which CSF is to

create the backup. The directory can be located on either a local drive or diskette but cannot be on a network drive. If both the archive and the backup are located on diskette, they must be on separate diskettes.

Creating a backup is optional, but be aware that if you do not create a backup when you apply service, you cannot use an older backup to restore your product. You cannot restore your product across multiple service levels. However, you can always restore your product to the archive level.

You can have only one backup of a product at a time. If a backup already exists when you request a backup, the older backup is deleted.

Backout

A unique, helpful feature of CSF is its uninstall or Backout facility. Backout, which restores your system to a backed-up or archived level, is accessed from the "Backed-Up Products and Archived Products" window.

The Backout facility is used if you ever want to return your system to its state before service was applied. When you back out of a fix or a ServicePak, you return to either the previous service level (if a backup exists) or to the archive level of the product. CSF locates the files in the BACKUP or ARCHIVE directory and restores them.

Backout restores only one back level of service. If a backup was not taken during the last application of service, then Backout to the previous level is not permitted. Note that a system can be backed out to the archived level at any time.

In the following example of using the Backout facility, the Backout service window is used to restore a product to its archive or backup level.

1. To display the Backout service window, select the "Change Product List" pushbutton.
2. To restore a product to its archive level, select the "Archived products" radio button. Select the products that are to be restored to the archive level, then select the "Backout" pushbutton.
3. To restore a product to its backup level, select the "Backed-up products" radio

button. Select the products that are to be restored to the backup level, then select the "Backout" pushbutton.

4. The Backout service window is displayed. Verify that the correct products are listed in the Products field and the correct level to which they will be backed out is displayed in the Target Level field. Then select OK to restore the product to the target level.

Separate Bootable CSF Diskettes

Bootable CSF diskettes are separate from the actual fix packages. This reduces your download time for obtaining fixes. You will have to download the CSF diskettes only once. You can then re-use them for future fixes.

Key CSF Files

SERVICE.EXE is a graphical interface for installing service to your system. It can be run from an OS/2 window or full-screen session.

SERVICE determines if the fixes can be applied to the targeted system and what the serviceable products are on that system. It also determines which files are to be backed up.

Service will install fixes to a running system. It will even allow locked files to be updated on a running system. CSF notifies you that it has detected locked files and that you must reboot for the changes to take effect. When the system is rebooted and before the operating system is loaded, CSF updates the files that were previously locked. It accomplishes this by loading a locked-file device driver early in the CONFIG.SYS file, before any other device drivers are loaded.

Figure 3 shows CSF installing a fix to a locked file (COM.SYS). As you see, when CSF detects that the file is currently locked, it displays a message indicating that the system must be restarted for the changes to take effect.

FSERVICE.EXE is a response-file-driven interface for installing fixes. It does not use the graphical environment used in SERVICE. FSERVICE performs unattended CID installations by using a response file.

Modify the FSERVICE response file only if you need to control the service application manually; otherwise, it automatically

services all partitions on your system. It is also used in manual installations on systems that must be booted using the CSF installation diskettes.

When FSERVICE is invoked, it automatically determines if the service can be applied and to which products it can be applied. It then determines which files are to be archived and backed up.

Other CSF files are listed in Figure 4.

CSF Future Directions

Today, CSF offers many useful features previously unavailable for installing service and archiving your system files. IBM hopes that as CSF rolls out to more and more users, their satisfaction in IBM's ability to install and distribute service will encourage more users to stay current with the latest version of their operating system.

To further ensure customer satisfaction and to increase the success and usability of CSF for installing service, IBM is working on enhancements such as the ability to install service from drives other than drive A:, as well as CSF availability on other platforms.

Currently each product uses its own unique install tools and service tools. The diversity of tools and techniques has caused training and systems administrator challenges as customers install and service the various products using the different tools. IBM recognizes the need for installation and service tools that are common across the software products and is continuing to work toward that goal.

Acknowledgment

I would like to thank Paul van der Meulen, the CSF project manager, who served as a technical reference for this article.

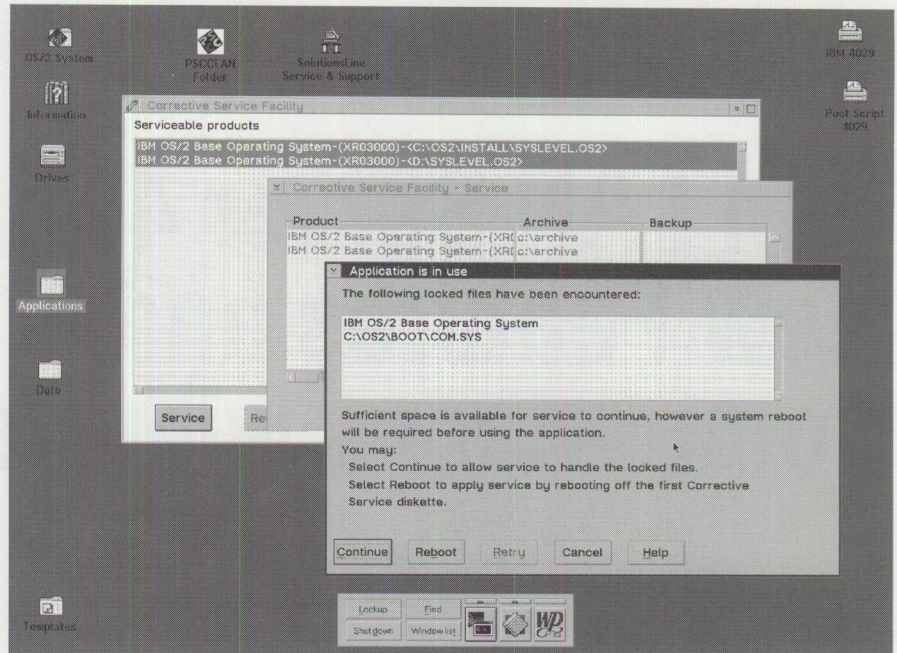
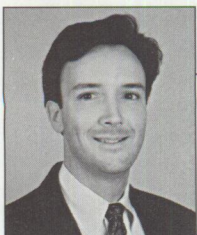


Figure 3. CSF Updating a Locked File

CSINI0S2.EXE	Initialization and exit-point files for pre- or post-service activities required for ServicePaks and FixPaks. These files, which are customized for every ServicePak, update video and/or printer drivers, modify INI files, update CONFIG.SYS files, and delete files.
CSEXT0S2.EXE	
IBMCSFLK.EXE	Files that pertain to the locked file device driver.
IBMCSFLK.SYS	
IBMCSFLK.DLL	
IBMCSFLK.MSG	
FS1.EXE	Bootstrap program used to initiate FSERVICE when booting from diskette.
CSFPANS.DLL	Dynamic link library (DLL) required to run FSERVICE.EXE during a diskette-booted installation. If FSERVICE is to be run from an OS/2 window, it must be placed where it can be found in the LIBPATH.
FSERVICE.MSG	Message file associated with the FSERVICE.EXE program.
SERVICE.HLP	Online help module for the PM interface. It must be located in the Help path.
RESPONSE.FIL	Default response file used by FSERVICE for a diskette boot. It can be modified to suit your requirements.

Figure 4. Other CSF Files



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IBM LAN Server 4.0: New Features and Comparisons with NetWare

This article covers the new features and enhancements in IBM LAN Server 4.0 and compares LAN Server 4.0 with Novell NetWare 4.02.

IBM LAN Server 4.0, announced in September 1994, has been a customer-driven product from the outset. Customers told IBM they wanted an easy-to-use, easy-to-install, and easy-to-administer network operating system (NOS). With its many new features and functions, LAN Server 4.0 provides these things and more.

LAN Server 4.0 Features

The major features in LAN Server 4.0 include a single logon, interoperability, coexistence, Open Software Foundation/Distributed Computing Environment (OSF/DCE) compliance, a non-dedicated server, and peer capability. Each of these features is now discussed in detail.

Single Logon: Network SignON Coordinator/2

Network SignON Coordinator/2, an added feature in LAN Server 4.0, is useful when your network is composed of different platforms and network operating systems. You can now give a user a single user name and password for connecting to LAN Server, NetWare, AS/400, and mainframe hosts. You and your users no longer have to perform multiple logons with multiple passwords and user names.

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Interoperability

With LAN Server 4.0, you can log on to a single domain and see only that domain, yet you can access multiple resources (storage devices and printers) across several different platforms: AS/400, mainframes, RISC System/6000, and Intel. This interoperability is achieved through interaction with other LAN Server packages—

LAN Server for AIX, LAN Server for AS/400, and LAN Server for MVS and VM (see Figure 1).

LAN Server for AIX allows existing DOS LAN Requester and OS/2 LAN Requester clients to access shared AIX resources such as file system (hard disk) and print queues. It works with Ethernet and Token-Ring topologies, using NetBIOS and transmission control protocol/internet protocol (TCP/IP) (RFC 1001/1002). Servers can be set up as primary, backup, and additional. This server is administered with OS/2 LAN Requester Full-Screen Interface (FSI) or AIX command-line interface.

The LAN Server for AS/400, a combination of hardware and software, allows existing DOS LAN Requester and OS/2 LAN Requester clients to access shared AS/400 file system (hard-disk) resources. It works with Ethernet and Token-Ring topologies, using NetBIOS and TCP/IP (RFC 1001/1002) protocols.

LAN Server's interoperability with LAN Manager clients, Windows NT Workstation clients, and Windows for Workgroups clients is excellent. Eventually you can upgrade these clients to LAN Server clients. Because you don't have to upgrade these clients immediately to access LAN Server 4.0, you can phase in client upgrades and reduce startup costs.

Client Coexistence on LAN Server

You can set up coexistence with LAN Server 4.0 on both the client and the server. On the OS/2 client, you can run NetWare Requester, OS/2 LAN Requester, TCP/IP for OS/2, PC Support for AS/400, and Communications Manager/2 (CM/2). This type of configuration lets a user access a NetWare server, OS/2 LAN Server, an AS/400, an IBM 3090 mainframe, and an AIX system simultaneously using a single workstation.

On the OS/2 LAN Server server machine, you can have NetWare Requester, OS/2 LAN Requester, TCP/IP for OS/2, and PC Support for AS/400, all accessing multiple file systems and printers. Then your clients need only have OS/2 LAN Requester installed to access all the file systems and printers. You can do this by defining the file system and printers as shared resources with an alias name; then you can NET USE the alias from the

client. For additional information about coexistence in an OS/2 environment, see the "NetBIOS, SNA, and NetWare IPX Coexistence in an OS/2 Environment" article in the September/October 1994 issue of *Personal Systems*.

NetWare generally uses Novell's proprietary Open Datalink Interface (ODI), which is not Network Driver Interface Specification (NDIS)-based. You cannot interoperate as flexibly with NetWare as with LAN Server, because NetWare allows coexistence with NDIS at the client but not at the server.

DCE Compliance

NetWare 4.02 is not currently DCE-compliant. Instead, NetWare 4.02 uses NetWare Directory Services (NDS), which is a proprietary subset of the X.500 standard. This may be a concern if you are looking at DCE as a future direction.

In contrast, LAN Server is on an open (DCE) path. If you have a large, enterprise-wide network and you are looking for a network operating system that will comply with OSF/DCE in the future, OS/2 LAN Server 4.0 is the one to choose.

Non-Dedicated Server Capability

Because LAN Server runs as an application under OS/2, the server computer does not have to be a dedicated server. You can run other applications, such as CM/2 or DATABASE 2 OS/2 (DB2/2), on the server, making use of OS/2's multitasking capabilities. (You can dedicate the server at any time by simply not running other applications on that computer.)

A non-dedicated server is useful in environments such as small businesses that cannot afford additional PC systems. A non-dedicated server can be used as a client workstation as well as a server.

To set up NetWare 4.02 as a non-dedicated server on OS/2, you need an additional software package: NetWare for OS/2 4.02.

Peer Capability with DOS/Windows and OS/2

LAN Server 3.0 offered peer capability for OS/2 LAN Requester clients. LAN Server 4.0 also offers peer capability with DOS clients running DOS LAN Services. Now a DOS client can share its hard disk and printer with other DOS and OS/2 users on the network.

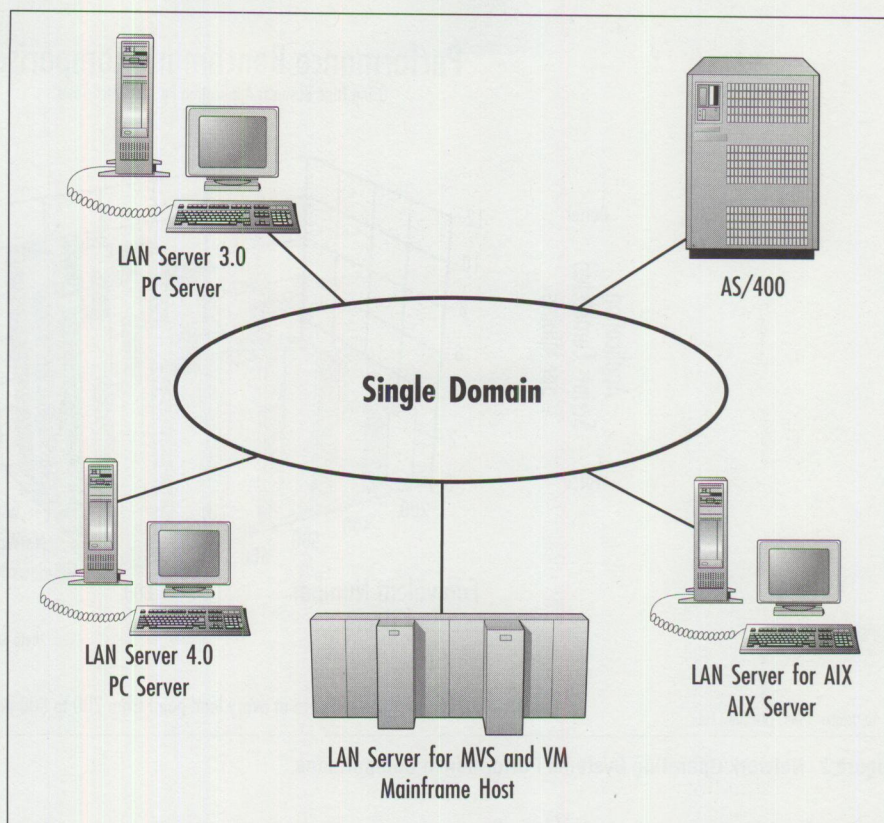


Figure 1. LAN Server Interoperability

NetWare 4.02 does not have this peer capability—to get it, you must purchase NetWare Lite.

Performance Improvements

LAN Server 4.0 includes a variety of performance improvements. The rest of this article discusses these improvements in detail.

Performance Comparisons

LAN Server 4.0 outperforms both NetWare and NT Advanced Server (NTAS).

OS/2 LAN Server 4.0, NetWare 4.02, and Windows NT Server were tested on a Compaq Proliant 40005/66 server with single and dual 66 MHz Pentium CPUs, 64 MB of RAM, and two Compaq NetFlex-2 ENET-TR controllers. Clients were 20 MHz Micro Channel systems using 16/4 Token-Ring cards. All three network operating systems were tested with up to 800 clients. The results (shown in Figure 2) show that OS/2 LAN Server 4.0 outperformed the other network operating systems. (Figure 2 comes from the report titled *LAN Server 4.0 Advanced, LAN Server 4.0 Entry, Novell NetWare 4.02, and Microsoft Windows NT Server 3.5 Performance Benchmark Comparison*

produced in October 1994 by LANQuest Labs and is reprinted with their permission. To obtain the full report, call [800] IBM-4FAX and request document number 2014.)

LAN Server 4.0 code exploits the Pentium processor's hardware caching technology, which increases server performance.

LAN Server Performance Tuning

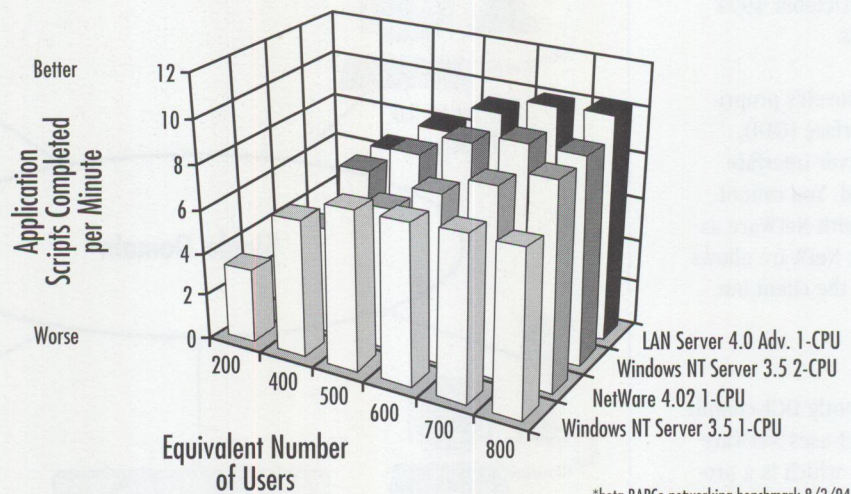
LS40TUNE.EXE (displayed in Figure 3) is an OS/2 Presentation Manager (PM)-based utility in LAN Server 4.0 enabling you to tune your LAN Server for a specified number of users and resources such as NetBIOS applications. The utility incorporates the spreadsheet (CNFGLS30) used in tuning LAN Server 3.0. It modifies CONFIG.SYS, PROTOCOL.INI, IBM-LAN.INI, and HPFS386.INI.

Changes made with the LS40TUNE.EXE utility do not take effect until you restart LAN Server 4.0 and the PC system. The LAN Server 4.0 Entry package is tuned by default for up to 32 users, while the LAN Server 4.0 Advanced product is tuned for up to 100 users.

In contrast, NetWare servers tune themselves dynamically—the server

Performance Benchmark Comparison

Using Nine Business Application Performance Tests*



*beta BAPCo networking benchmark 8/3/94

LAN Server has best performance at every load point from 200 to 800 equivalent users

© October 1994, LANQuest Labs

Figure 2. Network Operating Systems Performance Comparisons

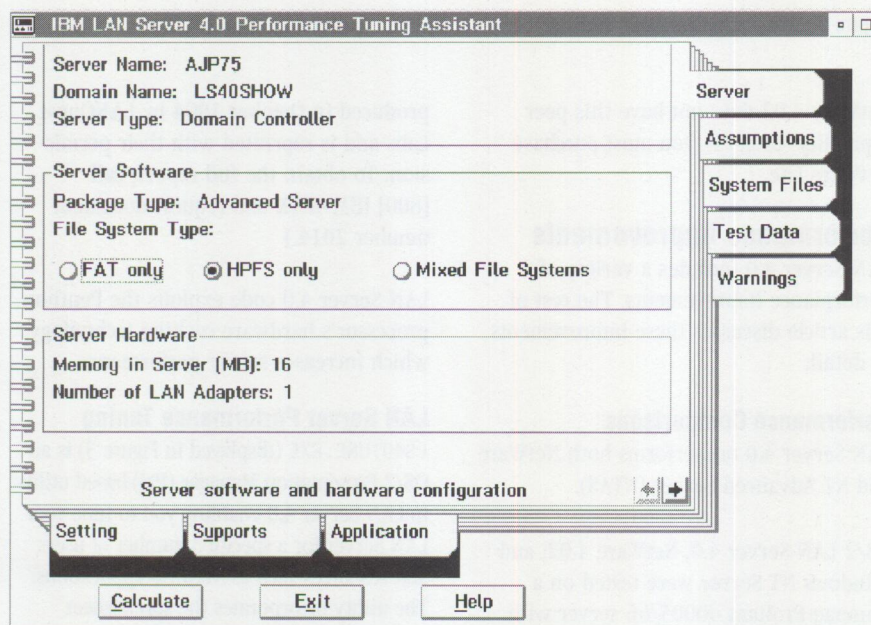


Figure 3. LAN Server Performance Tuning Utility

dynamically allocates memory to the server processes that need memory. This benefit, however, has a drawback: dynamic tuning consumes additional processing time. LAN Server 4.0 can be set up to have ranges of memory allocated for different server processes.

On the average, with proper tuning, LAN Server can easily handle the ups and downs of day-to-day resource usage by clients.

Adapter-Sniffing

A nice addition in LAN Server 4.0 is its adapter-sniffing capability. When you install the LAN Server code, it identifies your network adapter and its configuration. This simplifies the installation processes for the server and OS/2 LAN Requester. You won't have to open up your server system or workstation to identify its LAN adapter. NetWare 4.02 does not offer adapter-sniffing.

LAN Server 4.0 supports a large number of Ethernet and Token-Ring adapter drivers. Adapter manufacturers such as 3Com, Eagle, Novell, Artisoft, Cabletron, DCA, D-Link, Intel, Madge, Racal, SMC, Thomas, Conrad, and Xircom are among those whose drivers are provided in LAN Server 4.0.

IP Protocol Support

Unlike LAN Server 3.0 and earlier versions, LAN Server 4.0 now includes the internet protocol (IP) stack for the server and both OS/2 and DOS clients. This stack is important in LANs connected remotely via IP routers. Many large customers have IP routers that connect their remote sites to central corporate sites.

With LAN Server 4.0, you can configure all your clients and servers to communicate via IP using LAN Server's TCPBeui protocol, enabling you to use your existing IP wide area network (WAN) configuration to connect LAN Server servers with clients located at different sites.

NetWare 4.02 includes the IP protocol and its transport only at the server. For NetWare OS/2 and DOS clients, you must purchase an additional package—either NetWare LAN Workplace for DOS or NetWare LAN Workplace for OS/2. Both of these products provide the IP transport

along with file transfer protocol (FTP) capability using the ODI interface.

Multiple Protocol Transport Services

The network transport sets up the NetBIOS interface and the NDIS drivers for your LAN adapter. LAN Server 3.0 comes with Networking Transport Services/2 (NTS/2) for the transport. In LAN Server 3.0, you have to install NTS/2 first before installing OS/2 LAN Server and the OS/2 LAN Requester.

In LAN Server 4.0, NTS/2 has been superseded by Multiple Protocol Transport Services (MPTS). The MPTS transport installs automatically during OS/2 LAN Server and OS/2 LAN Requester installation.

CID Enablement

Configuration/installation/distribution (CID) installations reduce installation time for multiple clients in a networking environment. LAN Server 4.0 is CID-enabled. The DOS clients are now CID-enabled as well.

REXX and Macros

LAN Server 4.0 lets you set up REXX-based CMD (batch) files that can do administrative tasks. It also comes with macro applets that help you reduce the time you spend on repetitive tasks. These facilities are essential for handling the repetitive, time-consuming tasks that are required in networks with large numbers of users.

LAN Server Toolkit

LAN Server 4.0 comes with a LAN Server development toolkit intended for customers who have their own network application development staffs. This toolkit is an additional package for LAN Server 3.0. NetWare 4.02 does not include a development toolkit.

Mail Capability

No more light blue, full-screen messages! LAN Server 4.0's messaging utility is now OS/2 PM-based. If you are at a workstation and you get a message from another workstation, that message appears in an OS/2 PM-based pop-up screen (see Figure 4). You can then view, reply to, or save the message, plus send messages to single or multiple users.

While the mail capability in LAN Server 4.0 is not as robust as a full mail package, it is included at no additional

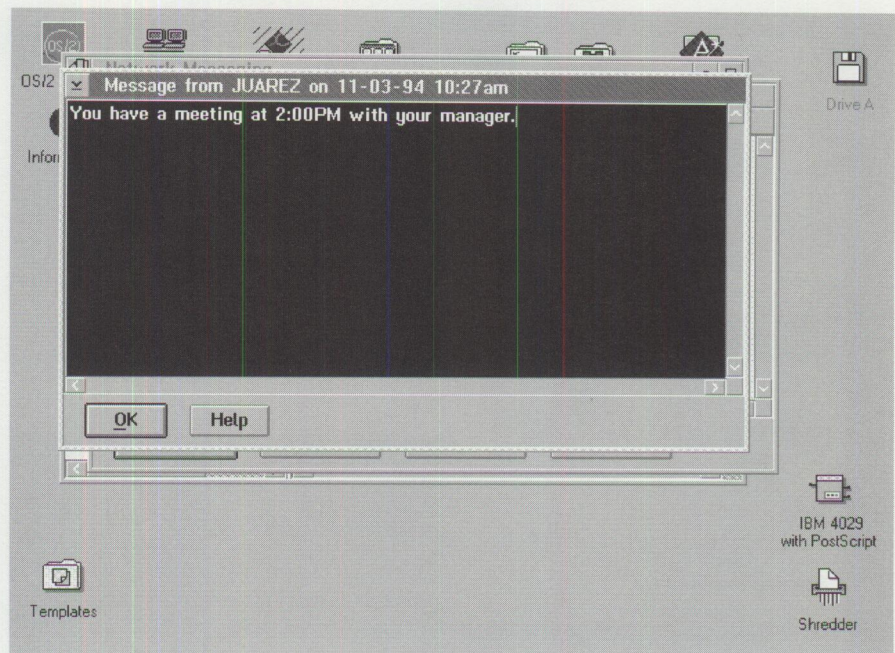


Figure 4. PM-Based Messages

cost. You can use it with as many clients as you have connected to your LAN Server domain.

Network DDE and Clipboard

Dynamic data exchange (DDE), available for Windows- and OS/2-based applications, links data dynamically between two applications. As you update the data in one application, it dynamically updates the data in the linked applications.

OS/2 allows DDE from an OS/2 DDE-enabled application to a Windows DDE-enabled application that is running in a multiple virtual DOS machine (MVDm) session. Network DDE takes this a step further by allowing you to link data via a LAN. Network DDE allows DDE from a Windows workstation in the LAN to an OS/2 workstation in the LAN. It also supports DDE from one Windows workstation to another Windows workstation or from one OS/2 workstation to another OS/2 workstation. Network DDE is available only for OS/2 and Windows applications, because DOS does not support DDE.

With Network DDE, you can also share data saved in one Windows-based workstation's clipboard and transfer it to an OS/2-based workstation's clipboard. NetWare 4.02 does not offer Network DDE and Clipboard capability.

Online Documentation

LAN Server 4.0 comes with a hard copy

manual titled *Up and Running!* This manual answers about 90 percent of the questions you will have during the first 30 days of using LAN Server 4.0. The rest of the manuals are in soft copy format, although you can purchase a hard copy set of these manuals at a reasonable price.

All LAN Server documentation is online. All the manuals are in INF format and can be read via OS/2's VIEW.EXE utility. When the manuals are installed, they are set up as book objects in a folder titled LAN Server Books. You need only double-click on the book you want to open. You can search by keyword through the manual, plus you can print the whole manual if necessary.

NetWare 4.02's online documentation uses a Windows-based graphical user interface (GUI) viewing utility. Novell also sells hard copy manuals for NetWare version 4.02, although at a high price.

Easy Installation

LAN Server 4.0 is much easier to install than previous versions. You need only run the installation program, INSTALL.EXE, from LAN Server Disk 1.

The first screen gives you two options: Easy and Tailored installation paths. The *Easy* path asks a few questions, then installs with a set of default parameters. LAN Server 4.0 Entry installs for 32

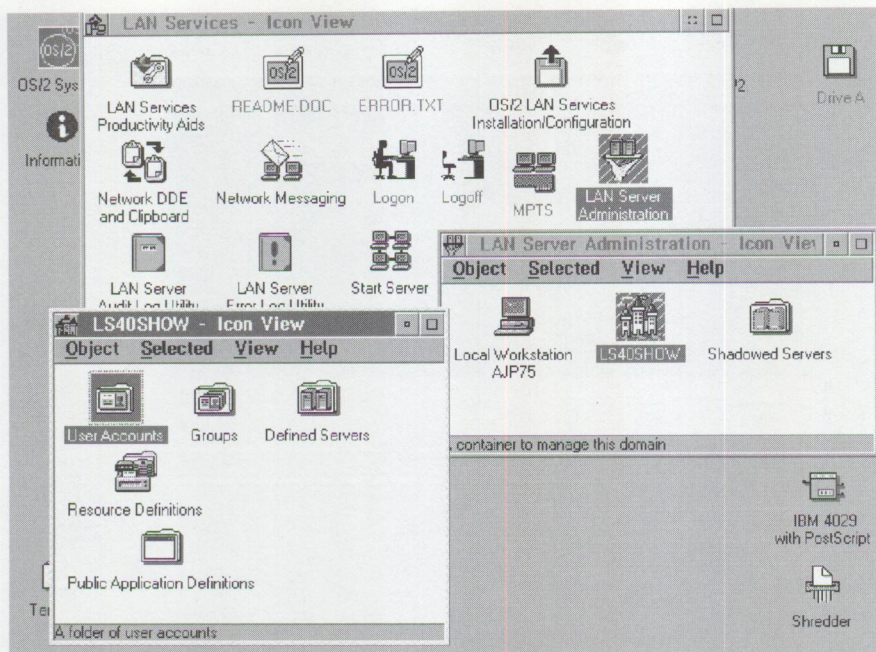


Figure 5. LAN Server 4.0 Administration Utility

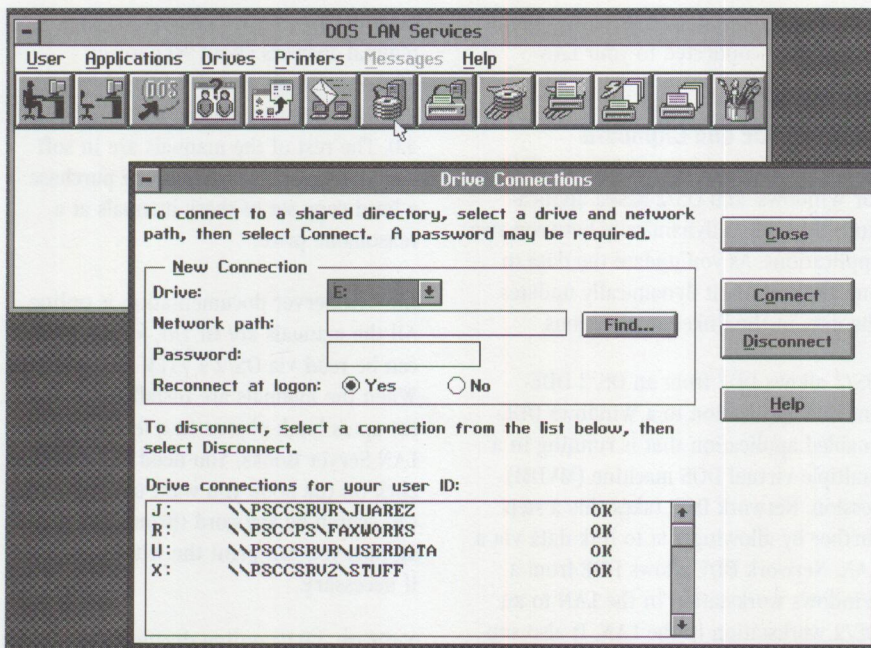


Figure 6. DOS LAN Services Graphical Utility

users; the Advanced version installs for 100 users. Each version is tuned for its respective number of users.

If you choose the *Tailored* path, you have the option of changing all the parameters for the LAN Server installation. (I recommend that only administrators who are very familiar with the network operating system make changes.) If you have more users than the default configurations set up, choose the Tailored path to configure for the additional users. You can also use

the LS40TUNE.EXE utility to tune the server for the additional users.

NetWare 4.02 provides quick-path cards that help during installation. However, I recommend that the average user read the installation section carefully before installing NetWare 4.02.

Object-Oriented Administration Utility

One of the nicest new features in LAN Server 4.0 is its System Object Model (SOM)-compliant administration utility

under OS/2 (see Figure 5). This utility is the equivalent of IBM OS/2 LAN Server 3.0's Full-Screen Interface (FSI) and User Profile Management (UPM) utilities. FSI is an ASCII-based, full-screen interface with pull-down menu options, and it is hard to maneuver. In contrast, the new LAN Server 4.0 administration utility is object-oriented and integrated with the Workplace Shell in OS/2. Now users, groups, aliases, domains, and public applications are objects within folders on the Workplace Shell.

You can now add users to groups by simply clicking on the user object, then dragging it onto a group object. Each folder—users, groups, and resources—has a template that can be dragged to create a new object. For example, you can click on a drive resource template and create a new one. When this is done, you will see a notebook with tabs requiring you to enter additional information.

If you are an administrator with OS/2 skills, you will find this utility very easy to work with. What used to take weeks to do now takes a few days with the LAN Server 4.0 administration utility. In fact, it took me only a couple of hours to feel comfortable with the utility. Also, I found LAN Server 4.0 and domains easier to understand and work with; it took me only a day to understand domains and to do a basic installation with users.

In contrast, the NetWare Directory Services Administration utility can take more than a week to get comfortable with. Because the NetWare 4.02 Administration utility is Windows-based, it is not object-oriented, thus limiting its drag-and-drop capability. I found NetWare 4.02 Administration more difficult to use and to administer. Also, because Directory Services is a big jump from bindery-based NetWare servers like NetWare 3.12 and NetWare 2.2, you will need additional education to understand NetWare 4.02 and NetWare Directory Services.

With its new administration utility, LAN Server 4.0 is easy to use and to administer. And, with its online documentation, an administrator or even a user can quickly learn to administer and use a LAN Server network. This ease of use makes LAN Server 4.0 an ideal NOS for small companies or branch offices.

DOS LAN Requester

In LAN Server 4.0, the DOS LAN Requester (DLR) is now called DOS LAN Services (DLS) and is 20 percent faster than DLR in LAN Server 3.0.

When installing DLS, you are given three options: Full Requester install, Base Requester install, and Virtual Windows install. If you plan to use advanced services like peer services and messenger, you should do the Full Requester install. If your system is short of memory, do the Base Requester install; if you are using Windows, do the Virtual Windows install. Either of the last two options can save you over 600 KB of base RAM.

LAN Server 4.0 has a new DOS graphical utility, NETGUI.EXE (see Figure 6). A mouse-driven utility, NETGUI has both a menu bar and icons for options such as sending messages to other users, assigning aliases as resources for the client, sharing printers and drives or directories, viewing the user list, and accessing public DOS applications from a LAN Server. In LAN Server 3.0, this utility was ASCII-based and full-screen with menu options.

Backward Compatibility

LAN Server 4.0 can be used with LAN Server 2.0, LAN Server 3.0, and even PC LAN Program (PCLP) dating back to 1985. This is very beneficial if your company has different versions of LAN Server. You can set up a LAN Server 4.0 primary server (domain controller) and have additional servers of different versions. You can even have different client versions attached to the domain. This backward compatibility saves you time and money since you don't have to upgrade all your servers at one time or even upgrade all your users at one time.

On the other hand, if you have NetWare 3.12 or NetWare 2.2 and are upgrading to NetWare 4.02, and if you want to use NetWare Directory Services, you will have to upgrade all your bindery-based servers (NetWare 3.12 and NetWare 2.2) to NetWare 4.02. You'll also have to upgrade all your clients as well, unless you want to utilize NetWare 4.02's bindery emulation, which is slow and does not allow you to

access Directory Services. NetWare 4.02 does not offer backward compatibility with the earlier versions of NetWare servers, versions 4.0 and 4.01.

Easy Migration

If you currently have LAN Server 2.x or LAN Server 3.0 servers and you want to upgrade them to LAN Server 4.0, you simply install version 4.0 on top of the older version. Users will not even notice that the migration occurred. However, they will notice some improvements in performance and in the online documentation.

NetWare to LAN Server Migration Utility

LAN Server versions 3.0 and 4.0 give you a migration path from NetWare 2.2, 3.11, and 3.12 bindery-based servers. This migration tool is an OS/2-based PM utility that you run on an OS/2-based workstation with both the NetWare Requester for OS/2 and IBM OS/2 LAN Requester.

When you log into both servers with supervisor status, the utility shows you a directory tree for both servers on a notebook-style screen. You can drag and drop directories from the NetWare directory tree to the LAN Server directory tree, then assign an alias to the NetWare server directory that is being moved over to the LAN Server drive. All users and groups, as well as permissions, are migrated across.

Because the migration tool requires you to have both the existing NetWare server and a new LAN Server, the migration tool is non-destructive (that is, the existing NetWare server is not destroyed during the migration and is still available).

The NetWare to LAN Server migration utility is not part of LAN Server 3.0 or LAN Server 4.0. It is available as an IBM Redbook (form number GG24-4388) with a disk containing the utility.

NetWare 4.02 provides a migration path from NetWare 3.x servers and a migration utility for LAN Server 1.3 to NetWare 4.02. NetWare's migration tool can be used to transform a NetWare 3.x server into a NetWare 4.02 server; however, this is considered a destructive migration tool since the process is irreversible.

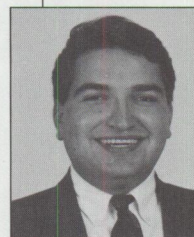
Pricing

LAN Server has always been sold on a pay-as-you-go basis. This means that you are charged for each client you purchase; so, if you have (for example) 26 workstations and one server, you purchase 26 client licenses and one server license. Later, if you need two more clients, you buy two more client licenses.

Servers like NetWare 4.02 are sold as server licenses with tiered pricing. So, if you have 26 users, you must buy a 50-user server license; if you have 600 users, you must buy a 1,000-user license. You cannot buy client licenses for NetWare 4.02. This can get expensive, depending how many users you have.

The Ideal Network Operating System

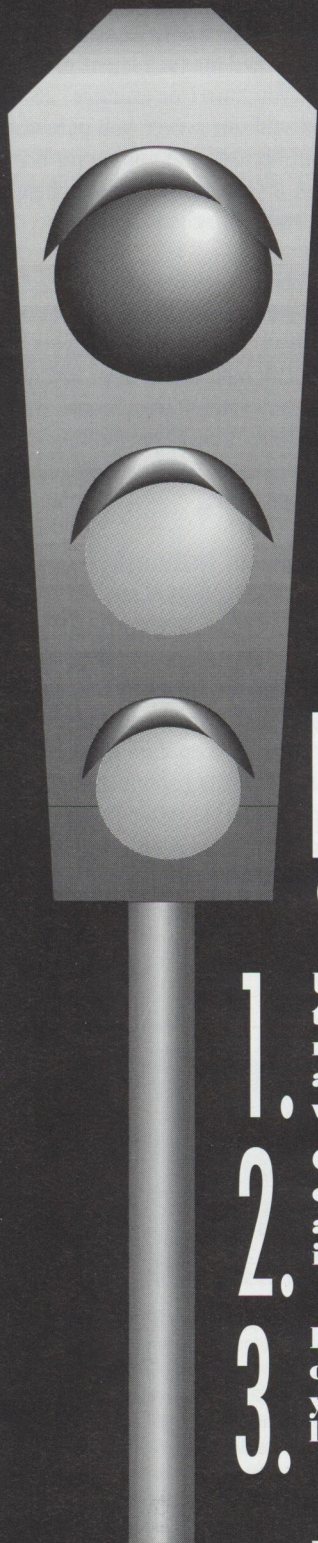
Out of the box, IBM OS/2 LAN Server 4.0 offers many nice features and performance improvements. Whether you are at a branch office with no dedicated administrator or a corporate headquarters office with a dedicated administrator, you will find LAN Server 4.0 to be the ideal NOS. And if you have a wide area network with TCP/IP and AS/400, mainframes, and AIX servers, LAN Server is an excellent choice.



Albert Juarez is a member of the Workgroup LAN Systems Support and Services Group in IBM's Personal Systems Competency Center in Roanoke, Texas.

Albert's mission is

to support LAN Server and OS/2 in IBM environments, specializing in interoperability with LAN Server, NetWare, and OS/2. He has over seven years of experience in the NetWare environment, including teaching courses about NetWare, and he has over three years' experience with IBM LAN products. Albert's credentials include Certified LAN Doctor, Novell Enterprise CNE, IBM Certified OS/2 Engineer, IBM Certified LAN Server Engineer, and IBM Certified OS/2 LAN Server Administrator. He has an Associate Degree in Electronic Engineering Technology from DeVry Institute.



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fast, free
information
about the products
and services
advertised in
Personal Systems?**

NO? With the heavy traffic of
new technology to choose
from in the personal
computer market, you need
to know about all the most
recent developments.
Caution.

- 1. Use the advertiser's index
to get the reader service
numbers of the products
and services for which you
want to receive literature.**
- 2. Circle the same numbers
on the reader service card
and fill out the necessary
information.**
- 3. Drop it in the mail (at no
charge!), and we'll give
your request the green
light!**

YES.
Smart move.

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IBM DCE Heterogeneous Enterprise Performance

This article presents some of the Distributed Computing Environment (DCE) performance characteristics observed in a moderately complex heterogeneous enterprise environment. A variety of OS/2-, AIX-, UNIX-, and Windows-based DCE systems have been brought together to study DCE application behavior as workloads scale up to more than 1,500 clients supported by 12 to 16 DCE and application server machines.

The IBM Point of Sale (PoS) DCE distributed application benchmark is used to drive the workload for this evaluation. These studies focus chiefly on the DCE topology performance, while noting the behavior of the DCE Administrator, OS/2 Database Manager, and Network File System (NFS) services contending for the system resources.

The primary objective in this article is to extend our DCE performance evaluation to a robust heterogeneous enterprise. (An overview of the enterprise is shown in Figure 1.) As the test environment becomes larger and more complex, the combinations of configurations become too many to adequately evaluate in one article. We have confined these studies to some of the performance questions that are asked most often. In the "Customer Requirements" section, we summarize our customers' feedback from meetings and surveys.

Our secondary objective in conducting these tests is to assure the behavior and performance of DCE for OS/2 and DCE for AIX in a diverse environment. We use off-the-shelf hardware and software to assemble a blended environment of IBM and non-IBM solutions.

Bob Russell
IBM Corporation
Austin, Texas

Our previous articles and reports (see "Appendix A: Related Articles and Reports") describe tests beginning with low-level, single DCE client/server measurements, progressing through a variety of small enterprise OS/2 and AIX topologies. The current studies are the next step in the progression and

build on the performance knowledge previously gained.

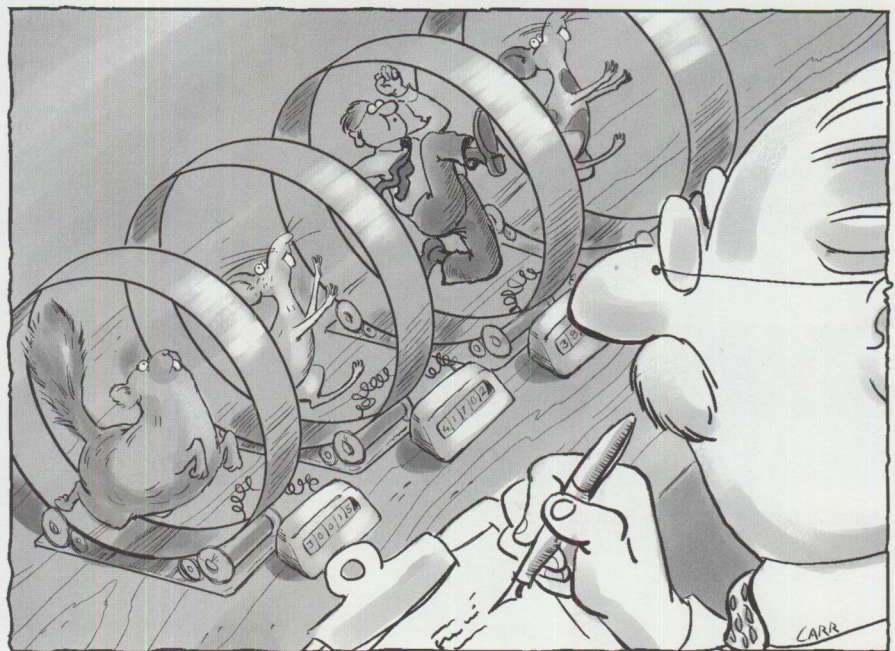
Customer Requirements

Our customers' questions and needs set the direction for our DCE enterprise performance test planning.

During the first half of 1994, we had several opportunities to meet with customers who are, or will be, implementing applications on DCE. Using the results of the question-and-answer sessions and surveys from these meetings, we updated the priorities for our upcoming DCE performance evaluation.

Based on the survey results shown in Figure 2 and on the availability of systems, the studies were updated to include:

- System workloads greater than 1,500 clients. The surveys indicate the highest interest is between 100 and 500 clients. Our previous report focused on



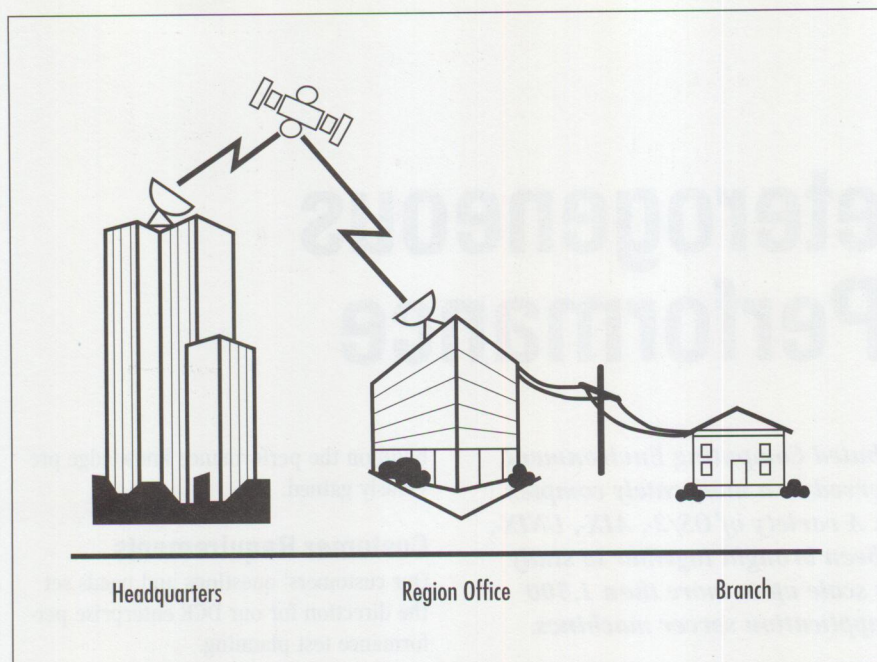


Figure 1. Enterprise Overview

Relative Importance (Normalized) (1 - Least Important / 10 - Most Important)					
Platform	Windows	OS/2	AIX	Midrange	Mainframe
Client Workstation	5	10	6	-	-
Application Server	-	10	9	4	3
DCE Server	-	9	10	3	2
Number of Clients	1-99	100-499	500-999	1000-4999	5000+
	2	10	7	5	1
System Geography	Building	City	State	Country	Global
	8	10	1	6	2
Application Characterization	Database	Data Transfer		Graphical	
	9	10		3	
Data Transfer Size	1 KB to 4 KB	32 KB to 64 KB		512 KB to 1 MB	
	10	6		4	

Figure 2. Customer Survey Results

this range. In this article, we are studying the second group, workloads up to 2,000 clients.

- Heterogeneous client and server environment. Some interesting clients were added, as well as new DCE and application servers:

- New clients: Windows, AIX/6000, Sun, and Hewlett-Packard workstations. See "Appendix B: Enterprise Clients" for more information about the clients.
- New DCE and application servers: Sun, Hewlett-Packard, and several additional PS/2 and RISC System/6000 systems.

- A comparison of the performance of a large single cell to the performance of two smaller cells.

- The performance of single and multiple cells connected by a wide area network (WAN). The survey feedback indicates the greatest interest in system geographies beyond a single contiguous location.

System Topology and Performance Studies

We analyzed and weighed the results of the customer surveys against our available resources in designing the system configuration for these studies. Our test system is a living organism; that is, as additional products on our "wish list" become available, they are added to the system at an appropriate breakpoint in our ongoing testing.

Our performance measurement philosophy in these tests is to view the system behavior from a high level. We do not use high-resolution timers to obtain microsecond-level measurements. Generally, we monitor end-user response time and system throughput and use the following guidelines to interpret the results:

- Response times less than one second are considered instantaneous.
- Response times greater than one second may be perceived by the user as a long time.
- The "maximum throughput" presented in the following discussions is the highest arrival rate applied to the system without causing an objectionable degradation in end-user response time.

In many of the results below, higher throughput could have been achieved. However, had we pushed the arrival rate any higher, the response times would have begun to grow above our one-second guideline.

We selected a "standard" system configuration for these studies (see Figure 3). The performance characteristics of the "standard" system are studied before introducing any variations.

The "standard" configuration is made up of three separate networks connected by WANs.

- "Headquarters" is the primary network and provides most of the system support. For the "standard" configuration, all DCE servers and PoS application servers are in the Headquarters network. The baseline throughput for the "standard" system at the Headquarters level (Figure 4) is 1,640 customer sales per minute (CSPM), and the 16 Mbps Token Ring is 40 to 45 percent utilized. That is, the PoS application servers in the "standard" configuration can support about 1,640 PoS clients. An OS/2 Database Manager online transaction processing (OLTP) benchmark is also running at 15 transactions per second (TPS) on a separate server and is not affected by the PoS traffic on the network.

- The "Region Office" is a smaller network connected to Headquarters by a high-speed WAN. We simulate the high-speed WAN using two IBM Token-Ring Network Bridge machines linked together by a 4 Mbps Token Ring. This is faster than the 1 Mbps links generally in use, but the Sniffer Network Analyzer indicated that the traffic on the 4 Mbps link remains below 0.8 Mbps during these tests. The maximum workload that can be exerted by the clients in the Region Office is 190 CSPM (Figure 4).

- The "Branch Office" is a small 16 Mbps ring with two physical PS/2 clients: one DCE for OS/2 and one DCE for Windows. The Branch Office is linked to the Region Office using IBM LAN Distance. For these tests, the physical link between the Branch and Region is a null modem set at 38,400 bps. The maximum throughput of the Branch

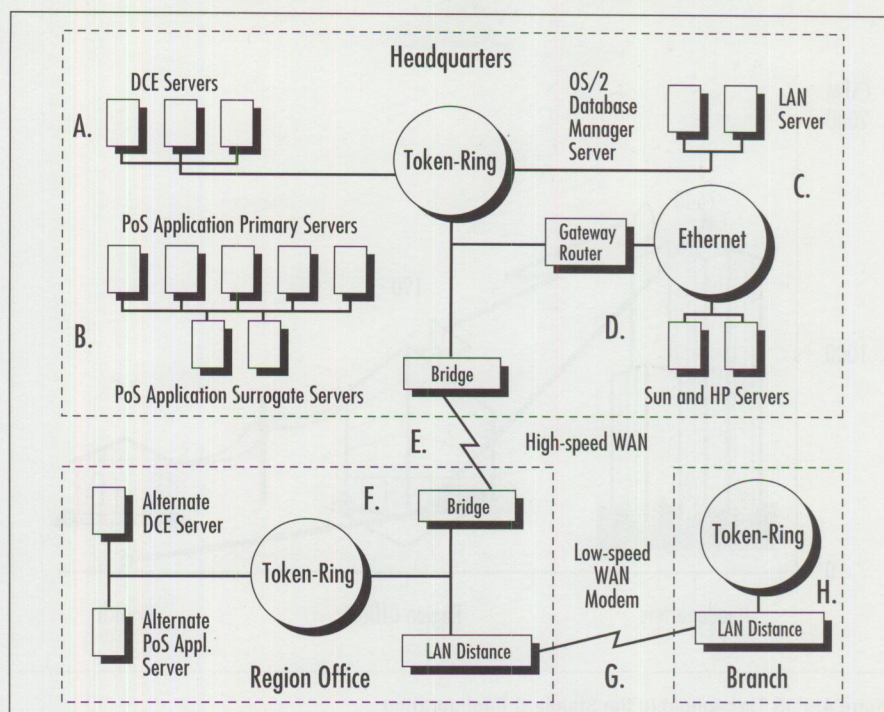


Figure 3. Enterprise Server Topology

Office (Figure 4) is limited to 7.5 CSPM by the line speed of the null modem.

The following benchmark applications provide the system load:

- The Point of Sale DCE application benchmark is patterned after a retail order-entry system. (More information about the PoS can be found in "Appendix A: Related Articles and Reports.") Since our objective is to look at DCE performance, the PoS workload is the predominant application in our environment.
 - A suite of `rgy_edit`, `acl_edit`, `rpccp`, and `cdscp` updates is run from one workstation. This simulates the ongoing activity of a DCE system administrator.
 - An IBM Extended Services (ES) 1.0 Database Manager OLTP benchmark using the NetBIOS transport for the Database Application Remote Interface (DARI) stored procedures is run on a small number of PS/2 clients in the Headquarters Token Ring.
 - IBM LAN Server/Requester 3.0 provides file-sharing for the various benchmark applications and tools. The LAN Server performance is not measured in the context of these studies.
- DCE Servers**
- For the discussion of DCE servers, refer to Figure 3, sub-topology A. In the "standard" configuration, the DCE servers are all PS/2 systems:
- The Primary Cell Directory Service (CDS) Server is a PS/2 9585-50 MHz. The CPU utilization remains under 40 percent during all tests. We find that changing the DCE servers has a very small impact on the overall cell throughput; the total difference is less than 5 percent between a PS/2 8595-33 MHz and a PS/2 9585-50 MHz, RISC System/6000 Models 220, 520, and 580, and the HP 9000 Model 827S.
 - The Secondary CDS server is either a PS/2 9577-50/25 MHz or 9585-50 MHz. It also remains less than 40 percent utilized.
 - The DCE Security and Distributed Local Time servers are on a PS/2 8595-33 MHz. The central processing unit (CPU) of the DCE Security server remains under 10 percent utilized, except when there is a flurry of DCELOGIN activity. There is no measurable impact when a

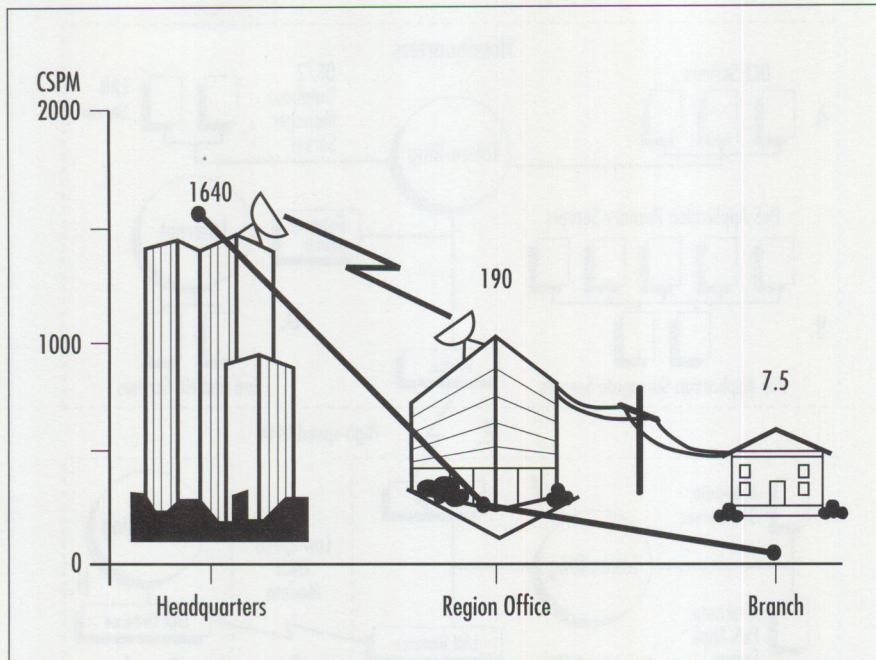


Figure 4. PoS Throughput in the Standard Configuration

faster RISC System/6000 or HP 9000 security server is used.

Security Registry

Increasing the size of the Security registry had the following effects (see "Appendix C: CDS Namespace and Security Registry Assumptions" for a description of the registry population):

- The disk space required for the Security registry grows by about 1 KB per principal and account, which is about 1 MB per 1,000 principals and accounts.
- The memory working set for the DCE Security server grows by about 1 KB for each unique host currently logged into DCE, again about 1 MB per 1,000 unique hosts.
- The cell throughput and response time of DCELOGIN are not measurably affected after adding the 1,000 principals and accounts.
- The only negative effects noted are that both the startup time of the Security Server Daemon (SECD), when the DCE Security Server is restarted, and the initial startup time of each client's Security Client Daemon (SCLIENTD) are about two times longer.

CDS Namespace

The effects of increasing the size of the CDS namespace are noted below. The memory and disk requirements for CDS

objects is somewhat higher than for security registry entities. (See "Appendix C: CDS Namespace and Security Registry Assumptions" for a description of the namespace population).

- CDS directory objects require 14.2 KB of CDS server memory and disk space for each object. Therefore, the 1,000 directory objects in our tests require 14.2 MB. The base Open Software Foundation (OSF) code allocates a maximum size of 14.2 KB per object regardless of the actual space needed. Generally, only about 11 percent of the allocated object space is actually used. Currently, there is no committed plan by the OSF technology provider to address this memory/disk concern.
- CDS program objects each require about 1 KB of CDS server memory and disk space, or 160 KB for the 160 program objects in our test cell's CDS namespace.
- There is no measurable effect on cell throughput or client response time.
- The only negative effect is on the CDS Server Daemon (CSDS) startup time, which increases up to 10 times.

PoS Application Servers

For the discussion of PoS application servers, refer to Figure 3, sub-topology B. The PoS application runs in a distributed configuration with five primary and two

surrogate PoS servers (Figure 5 illustrates the distribution of the four PoS server remote procedure call [RPC] routines). Each client imports a new RPC binding from the CDS server for one of the five primary PoS servers before each customer sale. The `rpc_ns_binding_import_next` application programming interface (API) randomly selects one of the five available PoS primary servers, thus providing a random and somewhat even distribution of workload across the five primary PoS servers.

The two surrogate PoS servers are shared by the five primary PoS servers, allowing all clients to access a single copy of the PoS Price and PoS Customer databases. The five primary PoS servers call the two surrogate servers through nested RPC calls within the PoS primary server application.

In the "standard" enterprise configuration, the following hardware supports the PoS application:

- The PoS Price surrogate server is on a RISC System/6000-580. The PoS Price RPC routine is called most often—2.5 times for every customer sale. The CPU and disk utilization of this PoS Price server is about 15 percent when the system throughput is 1,640 CSPM.
- The PoS Customer surrogate server is on a RISC System/6000-220. The CPU and disk utilization is about 65 percent at 1,640 CSPM. When a Model 520 is used in this role, the CPU is about 40 percent utilized.
- All five of the primary PoS servers are 33 MHz PS/2 Model 90s or 95s. At 1,640 CSPM, the CPU on all five primary servers is near 100 percent. This is indeed the bottleneck in the "standard" configuration. In order to achieve higher throughput, the primary PoS servers must be upgraded to faster hardware. A single RISC System/6000-580 primary PoS server is fully utilized at about 1,100 CSPM, suggesting that five 580s could support about 5,000 PoS clients.
- It might seem reasonable to substitute a faster machine for one or two of the primary PoS servers. However, this will not help, since the `rpc_ns_binding_import_next` DCE API call randomly distributes binding handles for multiple instances of the same application.

Hence the CPU capacity of the slower machines will continue to constrain the total throughput. A general rule of thumb is: Total throughput is equal to n times the throughput of the slowest machine, where n is the number of instances of the application server. In effect, the faster machine would respond more quickly but would be idle much of the time while most requests are queued in the slower machines. Therefore, to improve the total throughput, all instances of an application server must be upgraded to faster machines. This "feature" of DCE currently has no work-around.

Normally, the PoS clients import a new CDS binding handle from CDS for every customer sale. However, if the clients remain bound to the application server for longer periods, the throughput will be much higher. In the "standard" configuration, the throughput is 1,640 CSPM with rebinding for every customer sale. If rebinding is not done, the throughput increases to 2,080 CSPM. When there is not a specific need to rebind frequently, the PoS application improves 22 percent in total throughput.

Eliminating frequent rebinding drops utilization of the CDS server CPU from about 40 percent to near zero. The application server's CPU utilization also drops as a result of eliminating handshakes between the client and application server to negotiate the RPC authentication and re-establish the binding. The client's aggregate response time for a complete customer sale is reduced by about 0.5 seconds when rebinding is eliminated. Therefore, higher throughput can be achieved while maintaining acceptable end-user response time.

LAN and OS/2 Database Manager Servers

For the discussion of LAN and OS/2 Database Manager servers, refer to Figure 3, sub-topology C. Other enterprise support servers include:

- Two IBM LAN Server 3.0 domain controllers—an Advanced LAN Server and an Entry LAN Server. These domain controllers support sharing of benchmark programs, collection of performance data, and various network install services. All OS/2 systems are also LAN Requester 3.0 clients.

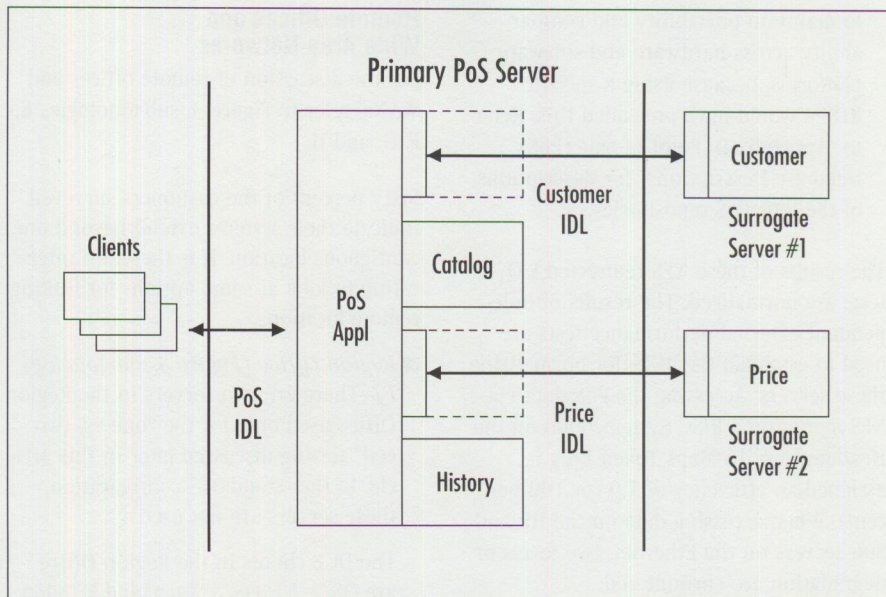


Figure 5. Distributed PoS Schematic

- OS/2 ES 1.0 Database Manager Server. This server supports the database OLTP benchmark clients and runs continuously to provide network loading.
- Network File System (NFS) for OS/2 Servers. The two LAN servers are also NFS servers. These compare the NFS I/O performance between OS/2, AIX/6000, SunOS/Solaris, and HP-UX servers.

The Token-Ring/Ethernet Gateway

For the discussion of the Token-Ring Ethernet Gateway, refer to Figure 3, sub-topology D.

The Headquarters network includes an Ethernet LAN segment to support the HP and Sun machines. The 16 Mbps Token Ring and 10 Mbps Ethernet are linked by a RISC System/6000-220 acting as a gateway router.

The Ethernet begins as a "thick wire" connection to the RISC System/6000 gateway, then to "thin wire," and finally to "10BASET" terminating at the Sun Sparcserver 1000. The HP 9000 827S server and 730 client are attached to the thin wire, and the Sun Sparcstation LX is attached to the thick wire.

Two simple tests evaluate the efficiency of this particular Token-Ring-to-Ethernet LAN gateway. It is not our mission or intent to compare the performance of specific hardware and operating system platforms, so we only make general observations about this LAN segment:

- The first Token-Ring-to-Ethernet gateway test measures a 4,096-byte "ping" from a single OS/2 client in each LAN segment. (The LAN segments are Headquarters Token-Ring segment, Headquarters Ethernet segment, Region Token-Ring segment, and Branch Token-Ring segment.) The OS/2 Transaction Control Protocol/Internet Protocol (TCP/IP) ping function is used for measurement, since it reports its response time with a timer resolution of 31 milliseconds. Each of the selected OS/2 workstations pings each of the 15 PS/2, RISC System/6000, HP, and Sun servers.

Within each subnetwork (Headquarters, Region, and Branch), the 4 KB ping responds in 31 to 34 milliseconds (one timer tick). A ping between the Region and Branch (null modem) is about 2,580 milliseconds; between the Region and Headquarters (4 Mbps link) is about 62 to 64 milliseconds; and across the Token Ring-to-Ethernet gateway adds 10 to 30 milliseconds.

- The second gateway test indirectly accesses the four PoS data repositories using the NFS mount command. For this test, a single instance of the PoS primary server is running.

Although applications usually employ a relational database manager (RDBM) to manage their data, the PoS data is stored in plain binary files and accessed using portable ANSI/POSIX C language calls. We made this decision

to maintain portability and comparability across hardware and software platforms, because using a specific RDBM would have precluded this. Refer to "Appendix D: Point of Sale (PoS) Database Descriptions" for descriptions of the four PoS repositories.

The results of these NFS redirected I/O tests are normalized. The results of independent external performance tests are used to establish the basis for normalizing these servers. Accessing the PoS data via NFS mount on a RISC System/6000 on the Headquarters 16 Mbps Token Ring is assigned an efficiency of 1.0 (or 100 percent). When accessing data on the HP and Sun servers on the Ethernet, two levels of degradation are encountered:

- When the NFS mount is from a Token Ring-attached PoS Primary server through the gateway to the Ethernet-attached servers, the efficiency is 0.75, meaning a 25 percent loss in maximum throughput.
- When the PoS Primary server is moved to the gateway server and the NFS mount is done from this gateway server, communication goes directly to the Ethernet adapter. The efficiency improves to 0.88, or only a 12 percent loss in maximum throughput.

Observations

We observed the following during the gateway tests:

- Although the line speed of the Ethernet is 10 Mbps, the Sniffer indicates the Ethernet remains less than 20 percent utilized. The CPU and disk of the HP and Sun NFS servers remain less than 30 percent utilized. This suggests the bottleneck is the communication adapter rather than the capacity of the HP or Sun NFS servers.
- When PoS Primary servers are switched between the RISC System/6000 Models 580, 520, and 220, the efficiency ratio is consistent. This suggests that server congestion and arrival rate are not factors in this test.
- When we compare the results of the independent performance tests on the RISC System/6000, Sun, and HP servers to our NFS throughput results, the inconsistencies further suggest a network hardware bottleneck.

Remote Offices and Wide Area Networks

For the discussion of remote offices and WANs, refer to Figure 3, sub-topologies E, F, G, and H.

Sixty percent of the customers surveyed indicate their systems extend beyond one contiguous location. It is therefore interesting to look at some options for linking remote locations.

- *Region Office (Figure 3, sub-topology F)*—There are two servers in the Region Office used only for the "one vs. two cell" testing discussed later in this article. In the "standard" configuration, these servers are not used.

The DCE clients in the Region Office are OS/2 2.1, OS/2 Warp, and Windows. In the "standard" configuration, these clients can exert the workload of 190 clients, or 190 CSPM. The 190 CSPM includes the 7.5 CSPM workload of the Branch Office. (The Branch Office is connected to the Region Office by an IBM LAN Distance null-modem line.)

Several tests evaluate the impact on performance of traversing the links. . .

- *Branch Office (Figure 3, sub-topology H)*—The Branch Office represents a remote location or "work-at-home" user connected to the Region Office using IBM LAN Distance and a modem. For our tests, we installed two PS/2 clients (one OS/2 and one Windows) on the Branch Token Ring. The maximum throughput of the Branch Office clients is constrained by the null-modem line speed.

- *High-Speed Link (Figure 3, sub-topology E)*—A typical high-speed link might be 1 Mbps. Since we do not have ready access to a link of this speed, we implemented a 4 Mbps link. Two PS/2 8570s, each with two Token-Ring adapters, are installed in the local office (16 Mbps) rings of both the Headquarters and the Region. These two bridge machines are connected by an isolated 4 Mbps Token Ring attached to their second adapter. The IBM Token-Ring Network Bridge Program is running on the two bridge machines.

When running the entire system at 1,640 CSPM, the Sniffer shows less than 0.8 Mbps flows across the 4 Mbps link. The throughput exerted by the Region Office is 190 CSPM. Therefore, if we assume a 1 Mbps link, the 0.8 Mbps traffic is nearly full utilization of the link. Thus, 190 clients would be about the maximum a single 1 Mbps link could support.

- *Low-Speed Link (Figure 3, sub-topology G)*—The Branch Office (H) is connected to the Region Office (F) using IBM LAN Distance. The physical link is a Null Modem set at 38,400 bps.

We did encounter a problem configuring the Windows client in the Branch Office. The increased response time across the null modem caused an unidentified time-out situation that terminated the Windows 3.1 desktop. When the Novell LAN Workplace 4.1 TCP/IP was replaced with the IBM TCP/IP, the problem was eliminated. The IBM TCP transport for DOS does not perform as well as either the Novell transport or the other two non-IBM transports for DOS that we have tested, and it would not normally have been our first choice.

Several tests evaluate the impact on performance of traversing the links between Headquarters and the Region Office and between the Region and Branch Offices. Figure 6 illustrates the portion of response times attributable to each link for the following tests. A normalized value of 1.0 is assigned to each test when performed locally on the Headquarters Token-Ring network. These measurements are from a single OS/2 client in an otherwise idle system.

- *TCP/IP 4 KB Ping*—Ping is probably the closest application to the TCP/IP transport level and most subject to the line speed of each LAN segment. Thus, it should be expected to have the greatest degradation across the WANs.

Between the Region office and Headquarters (4 Mbps), the ratio is 2:1 over the local "ping" case (i.e., the Region-to-Headquarters ping is two times slower than the local ping). This is fairly good, considering the 4:1 difference between the 16 and 4 Mbps line speeds.

Between the Branch and Region (38,400 bps), the ratio is 75:1, where the line speeds ratio is 426:1. Between the Branch and Headquarters (across both WANs), the ratio is 77:1.

■ **Authenticated RPC 4 KB Data**

Transfer—The next test uses an application program to transfer 4 KB of data from a client to a server in an authenticated RPC call. This test should be expected to perform better than the ping test, but since the application is still data-transfer-intensive, the degradation remains high due to the effect of the line speeds.

Using DCE Security “call” level authentication, the ratio is 36:1 across the 38,400 bps link and 1.4:1 across the 4 Mbps link.

Using DCE Security “packet privacy” (encryption) authentication level, the ratio is 8:1 across the 38,400 bps link and 1.1:1 across the 4 Mbps link. The ratio improves because the larger portion of the total response time is expended by the server and client encrypting and decoding the data packets.

- **PoS Customer Sale (the average data size is 3.2 KB, with a range of 1 to 16,384 bytes)**—In real life, the time spent within the client and server application is much longer than the time spent actually moving data across the network. Therefore, we should expect the response-time ratio to improve to a more acceptable level, since the RPC portion of the PoS application is less than 5 percent of the aggregate response time when run locally in Headquarters.

The PoS ratio between the Branch and Region on the 38,400 bps link is 9.2:1 and between the Region and Headquarters the ratio is 1.5:1.

- **DCE Calls**—Although many DCE functions and API calls make some number of RPC calls under the covers, most of the response time is spent in the client DCE programs.

- **DCELOGIN**—The ratio across the 38,400 bps link is 1.8:1 and across the 4 Mbps link is 1.4:1.

- **rpc_ns_binding_import_next**—The ratio across the 38,400 bps link is 2.3:1 and across the 4 Mbps link is 1.5:1.

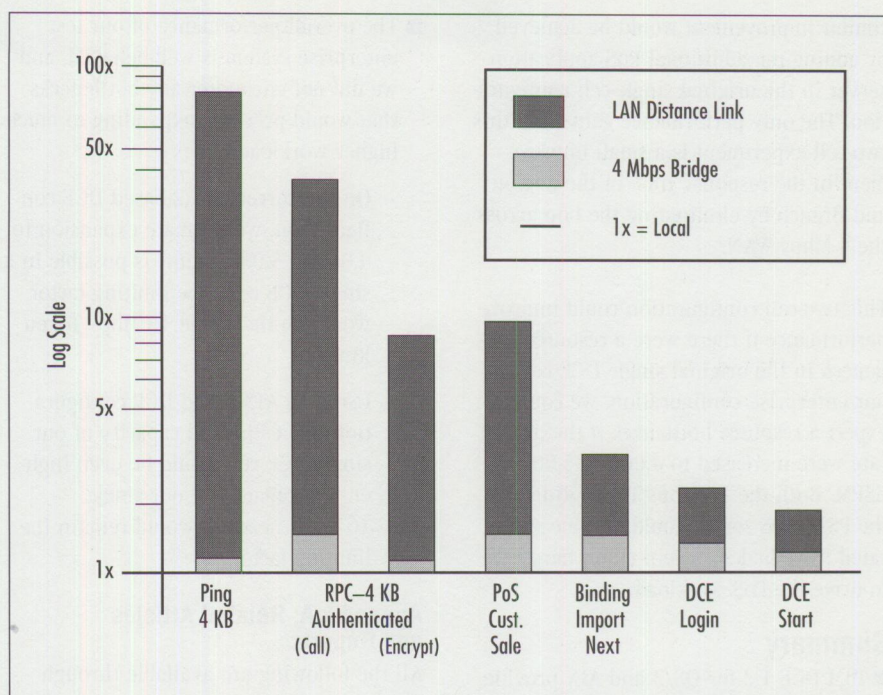


Figure 6. Response-Time Cost for WANs

- **DCESTART**—The ratio across the 38,400 bps link is 1.4:1 and across the 4 Mbps link is 1.3:1.

End-user response time across the wide area network is closely tied to the frequency and data size of data transfer operations. The PoS application makes an average of 5.5 RPC calls and seven DCE API calls for each customer sale. The overall response-time ratios for a complete PoS customer sale (null modem 9.2:1 and 4 Mbps link 1.5:1) are probably more representative of many interactive end-user applications across these specific WANs.

Since the two clients in the Branch Office are able to saturate the 38,400 bps link at 7.5 CSPM, this LAN Distance link can handle up to 7.5 clients under the best of conditions. In reality, LAN Distance is intended for a single client; and extrapolating from our results, a minimum 5,120 bps link would be sufficient for one client to maintain a 10-second RPC response time ($5.5 * 10 \text{ seconds} = 1 \text{ CSPM}$). See “Appendix E: IBM LAN Server Client 3.0 Tuning Tips for IBM LAN Distance” for hints on tuning the IBM LAN Server Client.

One Versus Two DCE Cells

For this experiment, we created a second DCE cell server and a PoS application server in the Region Office to handle both the Region and Branch

clients’ DCE and PoS activity, while the Headquarters cell handles only the clients on the Headquarters network. Both cells are running, and some amount of LAN Server activity is the only traffic across the 4 Mbps link between Headquarters and the Region Office. There is no DCE Global Directory Server (GDS) for this test.

- The throughput in Headquarters drops from 1,640 CSPM to 1,570 CSPM due to the reduced client horsepower. When we start up more clients to replace those now in the other cell, the throughput returns to 1,640 CSPM. Therefore, the capacity of the Headquarters’ DCE cell is neither diminished nor improved by splitting the Region and Branch off into a new cell.
- The throughput in the Region Office remains at 190 CSPM with a PS/2 8595 DCE server and a RISC System/6000-520 PoS server in the Region DCE cell. Since the RISC System/6000-520 can support about 360 PoS clients in this configuration, the 190 CSPM is clearly a limitation of the client’s ability to exert workload, rather than a limitation of either the WAN or PoS servers when configured in a single cell.

Implementing two DCE cells to eliminate traffic across the 4 Mbps WAN improves the aggregate throughput. However, a

similar improvement would be achieved by adding the additional PoS application server in the original single-cell configuration. The only performance gain from this two-cell experiment is a small improvement in the response time in the Region and Branch by eliminating the hop across the 4 Mbps WAN.

This two-cell configuration could improve performance if there were a resource bottleneck in the original single DCE cell. In our enterprise configuration, we could expect a resource bottleneck if the arrival rate were increased to 4,000 to 5,000 CSPM. Both the 16 Mbps Token Ring and the PS/2 CDS server could become saturated if we had sufficient client hardware to drive the PoS workload.

Summary

- IBM DCE 1.2 for OS/2 and AIX provide good performance and interoperability in our testing. IBM DCE 1.2 is based on OSF DCE 1.0.2.

- IBM DCE for AIX, Version 1.3 (OSF 1.0.3) will be generally available by the time this article is published. We ran a cursory set of tests in our enterprise system to:

- Assure functional compatibility with the OS/2 DCE 1.2 clients, the IBM DCE for Windows 1.0 clients, and with our current HP DCE/9000 1.2 installation.
- Assure there are no significant differences in the system performance.

- We encountered no performance problems while integrating the HP 9000-827S system into our test environment. The limiting performance factors for this server are attributable to our specific Token-Ring-to-Ethernet gateway and network hardware configuration.

- Using wide area networks provided satisfactory performance, given the line speeds. No DCE interoperability problems were encountered using IBM LAN Distance or IBM Token-Ring Bridge software.

- We encountered no interoperability or performance concerns while integrating OS/2, Windows, and AIX DCE clients.

- We encountered no network contention problems with DCE (TCP/IP), LAN Server (NetBIOS), and OS/2 Database Manager running concurrently.

- The overall performance of our test enterprise system is well-behaved, and we did not encounter any bottlenecks that would preclude expanding to much higher workloads.

- On the current OS/2-based DCE configuration, we estimate expansion to 4,000 to 5,000 clients is possible in a single DCE cell. The limiting factor would be the single 16 Mbps Token Ring.

- Using an AIX-based DCE configuration, the estimated capacity of our single DCE cell would be even higher. The capacity of our single 16 Mbps network would remain the limiting factor.

Appendix A: Related Articles and Reports

All the following are available through IBM:

Published in January/February 1994 *Personal Systems* magazine:

- "DCE: An Application Primer," by Phil Lieberman, Lieberman & Associates, Beverly Hills, California.

- "Performance of Key Functions in DCE for OS/2," by Cindy Corn, Tim Li, Ray Pekowski, and Bob Santeford, IBM Austin.

- "IBM DCE for OS/2 Multiuser Application Performance," by Benetta Perry and Bob Russell, IBM Austin.

Published in July/August 1994 *Personal Systems* magazine:

- "Distributed Performance Characteristics of IBM DCE for OS/2," by Benetta Perry and Bob Russell, IBM Austin.

IBM white paper: (Ask your IBM representative for DCEPERF, located on MKTTOOLS.)

- "Performance of Key Services in IBM DCE Client for Windows" by Ray Pekowski, IBM Austin.

Appendix B: Enterprise Clients

A variety of clients are used to drive the workload through our enterprise system:

- *OS/2 DCE clients.* The majority of clients for these tests are OS/2 DCE clients configured with OS/2 2.1, DCE 1.2, and LAN Requester 3.0. The systems consist of the following

hardware: IBM PS/2 8557, PS/2 8580, IBM ValuePoint 6384, and Dell 433/L systems.

Each OS/2 client runs multiple instances of the PoS client application in separate OS/2 processes. The maximum workload that can be exerted on the system varies by the hardware model: the PS/2 8557-20 MHz can simulate 60 clients, the PS/2 8580-25 MHz can simulate 75 clients, the Dell 433/L 33 MHz can simulate 150 clients, and the ValuePoint 66 MHz can simulate 390 clients. These numbers are approximate and represent the load exerted as the client CPU nears 100 percent utilization. The aggregate loading capacity of all the PS/2, ValuePoint, and Dell clients in the system is a little over 2,400 simulated clients. In some tests, additional PS/2 486-33 MHz and RISC System/6000 clients are added to ensure sufficient loading.

- *OS/2 Warp beta.* A small number of OS/2 clients are running on the OS/2 Warp beta (the 3 to 4 MB version of OS/2).

- *DCE Administrator.* A DCE Administrator script runs continuously on one OS/2 client workstation. The script exercises `cdscp`, `rgy_edit`, `acl_edit`, and `rpccp`. Each iteration of the script runs for about 2.5 minutes and returns the cell configuration to the starting state upon completion. Overall, there is no measurable impact on system throughput with the script running.

- *Windows DCE clients.* Several PS/2 Model 8557 workstations are running PC DOS 6.1, Microsoft Windows 3.1, IBM DCE for Windows 1.0 (PC-DCE 1.0.1b), and Novell LAN Workplace 4.1 TCP transport. Each Windows DCE client can exert the workload of up to 12 clients.

- *DCE for AIX clients.* Some number of PoS clients are running on one or more RISC System/6000 machines. Although the RISC machines have the capacity to exert a great deal of client loading, we do not fully exploit this horsepower. One PoS client is run on one or more RISC machines when they are not acting in a critical server role.

- *Sun client.* We have one Sun Sparcstation LX client. Although the Sun client participated in some of our

tests, the PoS benchmark client program has not yet been ported to the Sun platform.

- **OS/2 Database Manager clients.** A small number of OS/2 ES 1.0 Database Manager clients are running on PS/2 Model 8557s. The database server for the database OLTP benchmark is a dedicated PS/2 Model 8595. The OLTP benchmark uses the NetBIOS transport for the Database Application Remote Interface (DARI) stored procedures. A throughput of about 15 TPS is maintained to add network load. There is no impact on either DCE or OLTP throughput while both applications are running concurrently.

About two-thirds of the client workload is provided by OS/2, with the remaining workload provided by Windows, AIX, and UNIX workstations.

The simulated number of clients is in the 1,500 to 2,000 range. Simulating clients is achieved in two ways: (1) by using multiple OS/2 and AIX processes on a single workstation to fully utilize the client processor, and (2) by varying the arrival rate (think time) to pace the workload applied to the system. The workload assumption for the Point of Sale benchmark application is one complete PoS customer sale to be submitted every minute by each client. Thus, throughput expressed as Customer Sales Per Minute (CSPM) equates to the number of clients that can be supported in a particular configuration.

The Windows clients each run only one PoS client session. The performance of the Windows client is about half that of the OS/2 client; that is, one OS/2 process exerts twice as much throughput load on the system as one Windows client. This is primarily due to the graphical user interface (GUI) running in an asynchronous OS/2 Presentation Manager thread while the GUI is somewhat synchronous in the Windows client.

Appendix C: CDS Namespace and Security Registry Assumptions

The DCE Cell Directory namespace and Security registry is initially populated to simulate a 1,000-user system. To determine the population of these databases for a 1,000-user system, statistics were collected from larger LAN Server customers. These statistics indicate that a typical LAN

server supports 50 users and provides 50 shared directories and six to eight shared applications. Extrapolating this information to a 1,000-user DCE system, we initialized the DCE Security registry with 1,000 accounts and principals in 20 groups. The DCE Cell Directory namespace is initialized with 1,000 directory objects and 160 program objects.

Appendix D: Point of Sale Database Descriptions

The four PoS data repositories (or databases) are:

- **PoS Customer data file**—This file contains 100,000 entries of 512 bytes each and a 1.2 MB index file. There is one lookup per PoS Customer sale and three "read" requests per lookup. The user enters the area code and phone number to initiate the lookup.
- **The PoS Catalog**—This repository consists of five subdirectories, each containing one thousand 16 KB image files. Each catalog transaction does an open, read 16 KB, and close of one image file, and one catalog page is retrieved for each customer sale. The user selects the catalog and page to be viewed.
- **The PoS Price data file**—This file contains 100,000 entries of 168 bytes each and a 272 KB index file. There are 2.5 PoS Price lookups for each customer sale (the range is 1 to 4, randomly) and two "read" requests for each Price lookup. The user selects the lookup items from the currently displayed catalog page to initiate each search.
- **The PoS History file**—The PoS History transaction is "write" only, appending 284 to 788 bytes (depending on the number of price items) to a previously opened file. The history thread is locked during each append. This repository could be used to prepare the customer's invoice and delivery slip. In future tests, a separate program will read this data and send a print stream to a DCE Distributed Print Server.

Appendix E: IBM LAN Server Client 3.0 Tuning Tips for IBM LAN Distance

When we initially installed the LAN Distance link, some LAN Server Client 3.0 time-out problems were encountered due to the longer response times across the null modem. The following changes were recommended by our LAN Distance performance analyst:

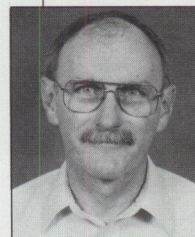
- In the IBMLAN.INI file, wrkheuristics bits 0, 6, 8, 9, and 11 were changed to 0 and sizeworkbuf was changed from 512 to 4096
- In the PROTOCOL.INI file (NETBEUI.NIF section), dlcretries was changed to 20, T1 was changed from 30000 to 60000, T1 was changed from 500 to 10000, and T2 was changed from 200 to 2000.

Appendix F: Acknowledgments

I would like to acknowledge the time and expertise contributed by Tom Boes for porting PoS and supporting the AIX and HP-UX platforms, and by Piers Hendrie for porting PoS to Windows 3.1.

A special thanks to Ben Hoflich, our summer co-op from the University of Texas, for setting up and configuring the enterprise system variations and conducting the many tests and experiments.

Thanks to Laura Adams for coming to my rescue and working her magic on the final version of this article.



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OS/2, DOS, and Windows NT Coexistence

Scenario	Installation Sequence	Results
1	Windows NT and OS/2	Successful
2	Windows NT, DOS, and OS/2	Successful
3	DOS, Windows NT, and OS/2	Unsuccessful
4	DOS, OS/2, and Windows NT	Unsuccessful
5	Dual Boot and Windows NT	Cumbersome

Figure 1. Installation Scenarios

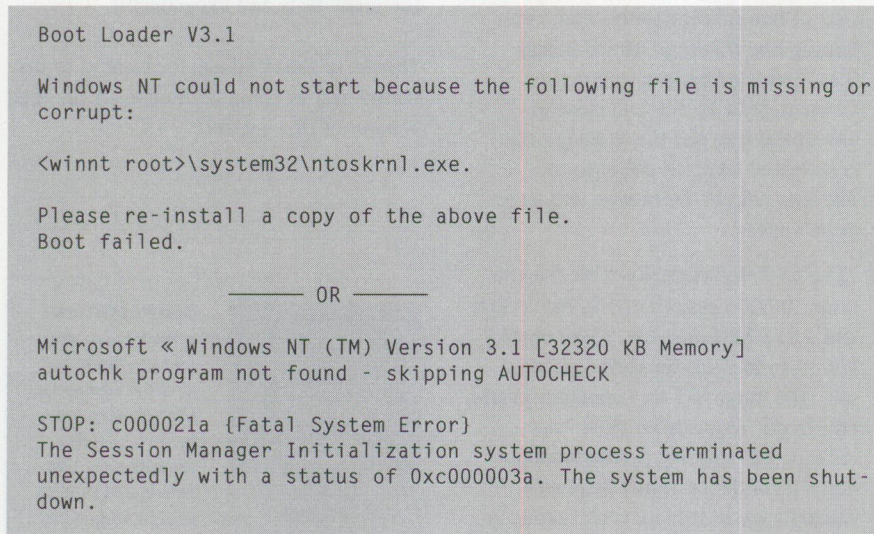


Figure 2. Windows NT Error Messages

Depending on the installation sequence, OS/2, DOS, and Windows NT can all reside and run successfully on the same computer system. This little solution describes the installation scenarios shown in Figure 1 and discusses their results.

This article does not discuss the steps for actually installing each operating system. For detailed installation information on each of these operating systems, please refer to their respective installation manuals.

Scenario 1: Windows NT and OS/2

Installing Windows NT and then OS/2 does not install the Boot Loader. The Boot Loader is an NT feature that allows you to select an operating system for your PC to use at startup. You do not want to install the Boot Loader in this coexistence scenario for two important reasons:

- Boot Loader must be installed in a File Allocation Table (FAT) partition
- Boot Loader and OS/2 Boot Manager are incompatible

If both the Boot Loader and Boot Manager are installed, Windows NT will fail with one of the errors shown in Figure 2.

Performance is a primary concern in these coexistence scenarios. While the NT File System (NTFS) and High-Performance File System (HPFS) ensure maximum system performance, you should install your applications on an HPFS partition. Windows NT can access data in an HPFS partition, but OS/2 cannot recognize data on an NTFS partition.

Figure 3 shows the partition information needed for installing Windows NT and OS/2 in Scenario 1.

To install Windows NT first:

1. Begin the Windows NT installation process.
2. Create a primary partition for Windows NT, a logical partition for OS/2, and another logical partition for your applications.
3. Format the primary partition as FAT or NTFS.
4. Complete the Windows NT installation.

Note: After Windows NT is installed, boot into the Windows NT environment to ensure it functions correctly.

Now install OS/2:

1. Begin the OS/2 installation process.
2. Install to a drive other than drive C:. Use FDISK to create a partition for OS/2, a partition for applications, and a 1 MB Boot Manager partition.
3. Format the logical partitions as HPFS (for OS/2) and HPFS or FAT (for applications).
4. Complete the OS/2 installation.

When you restart your system, Boot Manager will let you select either Windows NT or OS/2.

Scenario 2: Windows NT, DOS, and OS/2

Because DOS cannot recognize data on an NTFS or HPFS partition, you should install all of your applications on a FAT partition. OS/2 and Windows NT can access the FAT partition with no problem.

Figure 4 shows the partition information needed for installing Windows NT, DOS, and OS/2 in Scenario 2.

To install Windows NT first:

1. Begin the Windows NT installation process.
2. Create a primary partition for Windows NT, a logical partition for OS/2, and another logical partition for your applications.
3. Format the primary partition as FAT.
4. Complete the Windows NT installation.

Note: After Windows NT is installed, boot into the Windows NT environment to ensure it functions correctly.

Install DOS next:

1. Insert the first DOS installation diskette.
2. Reboot the computer by pressing Ctrl, Alt, and Delete simultaneously.
3. Install DOS.

Finally, install OS/2:

1. Begin the OS/2 installation process.
2. Format the first logical partition (drive D:) as HPFS.
3. Install Boot Manager and set the start-up values to boot either Windows NT, DOS, or OS/2.
4. Complete the installation.
5. Format the last logical partition (drive E:) as FAT for your applications.

When you restart your system, Boot Manager will let you select either Windows NT, DOS, or OS/2.

Partition Type	Drive	Size
OS/2 Boot Manager		1 MB
NTFS (for Windows NT)	C: (primary)	100 MB
HPFS (for OS/2)	D: (logical)	100 MB
HPFS (for applications)	E: (logical)	as large as possible

Figure 3. Partition Information for Scenario 1

Partition Type	Drive	Size
Boot Manager		1 MB
FAT (for Windows NT)	C: (primary)	100 MB
FAT (for DOS)	C: (same as above)	50 MB
HPFS (for OS/2)	D: (logical)	100 MB
FAT (for applications)	E: (logical)	as large as possible

Figure 4. Partition Information for Scenario 2

Remaining Scenarios

Scenarios 3, 4, and 5 are shown for your information only. We do not recommend that you attempt to install your system as described in these scenarios. They will not provide you with a successful installation.

Scenario 3: DOS, Windows NT, and OS/2

DOS and Windows NT will coexist on a single system. The Windows NT Boot Loader allows you to boot either DOS or Windows NT. As previously mentioned, when you install OS/2 and Boot Manager, the Boot Loader becomes corrupted and Windows NT fails.

Scenario 4: DOS, OS/2, and Windows NT

DOS and OS/2 will coexist on a single system with Boot Manager providing the capability to select either operating system. When Windows NT is added to this system, the Boot Loader is automatically installed. Because the Boot Loader is incompatible with OS/2's Boot Manager, Windows NT will fail.

Scenario 5: Dual Boot (Between OS/2 and DOS) and Windows NT

A dual boot environment is not the most efficient method to use if you want OS/2, DOS, and Windows NT to coexist on a single system. This installation functions normally, but it is cumbersome to switch between the three operating systems.

If you were booted to DOS when Windows NT was installed, you would be presented with the Boot Loader each time you boot to DOS. From there you can select either DOS or Windows NT. When you are in OS/2 and want to boot to Windows NT, you must first boot to DOS and then select Windows NT from the Boot Loader.

If you were booted in OS/2 and you shut down to install Windows NT, you would be presented with the Boot Loader each time you boot to OS/2. From here, you can select either OS/2 or Windows NT. If you are in DOS and want to boot to OS/2 or Windows NT, you must first boot to the Boot Loader and then select either OS/2 or Windows NT.

—David Kelbley and Tony White,
IBM Corporation, Roanoke, Texas

OS/2 for SMP and Windows NT Coexistence

```
Boot Loader V3.1

Windows NT could not start because the following file is missing
or corrupt:

<winnt root>\system32\ntoskrnl.exe.

Please re-install a copy of the above file.
Boot failed.

      OR

Microsoft « Windows NT (TM) Version 3.1 [32320 KB Memory]
autochk program not found - skipping AUTOCHECK

STOP: c000021a {Fatal System Error}
The Session Manager Initialization system process terminated
unexpectedly with a status of 0xc000003a. The system has been
shutdown.
```

Figure 1. Windows NT Error Messages

Partition Type	Drive	Size
Boot Manager		1 MB
NTFS (for Windows NT)	C: (primary)	100 MB
HPFS (for OS/2 for SMP)	D: (logical)	100 MB
HPFS (for applications)	E: (logical)	as large as possible

Figure 2. Partition Information

This little solution describes how to install OS/2 for Symmetric Multiprocessing (SMP) and Microsoft Windows NT on a single, multiprocessor computer system. There will often be a need to run OS/2 for SMP and Windows NT from a single computer system, particularly in laboratory environments involved in application compatibility testing. The procedure for installing both operating systems on a single system is not obvious. This little solution provides you with an installation scenario that will ensure both operating systems function properly.

When installing these two operating systems on a single computer, install Windows NT first and then OS/2 for SMP and Boot Manager. Boot Manager allows you to select either Windows NT or OS/2 for SMP each time you boot your system.

These guidelines are not meant to replace the OS/2 for SMP or Windows NT installation manuals. For detailed information on installing these operating systems, please refer to the manuals for each operating system environment.

Installation Process

Installing Windows NT first and then OS/2 for SMP will bypass installing the Boot Loader. The Boot Loader is an NT feature that allows you to select an operating system for your PC to use at startup. You do not want to install the Boot Loader in this coexistence scenario for two important reasons:

- Boot Loader must be installed in a File Allocation Table (FAT) partition
- Boot Loader and OS/2 Boot Manager are incompatible

If both the Boot Loader and Boot Manager are installed, Windows NT will fail with one of the errors shown in Figure 1.

Performance is a primary concern in this coexistence scenario. While the NT File System (NTFS) and High-Performance File System (HPFS) ensure maximum system performance, you should install your applications on an HPFS partition. Windows NT can access data on an HPFS partition, but OS/2 cannot recognize data on an NTFS partition.

Figure 2 shows the partition information needed for installing Windows NT and OS/2 for SMP.

Install Windows NT first:

1. Begin the Windows NT installation.
2. Create a primary partition for Windows NT, a logical partition for OS/2 for SMP, and another logical partition for your applications (which will be installed later).
3. Format the primary partition as NTFS.
4. Complete the Windows NT installation.

Note: After Windows NT is installed on Drive C:, boot into the Windows NT environment to ensure it functions correctly.

Install OS/2 for SMP next:

1. Begin the OS/2 for SMP installation.
2. Install to a drive other than drive C:.. Use FDISK to define a partition for OS/2 for SMP, a partition for applications, and a 1 MB Boot Manager partition. Set the startup values to boot either Windows NT or OS/2 for SMP.
3. Format the logical partitions as HPFS.
4. Complete the installation.

When you restart your system, Boot Manager will let you select either Windows NT or OS/2 for SMP.

—David Kelbley and Tony White,
IBM Corporation, Roanoke, Texas

Corrective Service Information

Figure 1 shows maintenance release levels for the listed products. This information is effective as of November 18, 1994. CSDs may have been updated since press time.

To order all service packages—except for the OS/2 2.0, OS/2 2.1, OS/2 2.1 for Windows, and OS/2 2.0 Toolkit ServicePaks—call IBM Software Solution Services at (800) 992-4777. For the OS/2 2.0 ServicePak (XR06100), OS/2 2.1 ServicePak (XR06200), OS/2 2.1 for Windows ServicePak (XR06300), or the

IBM Developer's Toolkit for OS/2 2.0 ServicePak (XR06110) on diskettes or CD-ROM, call (800) 494-3044. Most OS/2 service packages are also available electronically from the following sources:

- **OS/2 Bulletin Board Service (BBS):** Once connected, select Option 2. (Corrective services are also listed under the General category on the IBMLink BBS.) To subscribe to the OS/2 BBS, call (800) 547-1283.
- **IBM Personal Computer Company (PCC) BBS:** Call (919) 517-0001.

Service packages are located in Directory 4.

- **CompuServe:** Download service packages from the IBM OS2 FORUM library (GO IBMSERV).
- **Internet:** Do an anonymous FTP from software.watson.ibm.com. Most packages are located in the \PUB\OS2 directory. TCP/IP packages are located in the \PUB\TCPIP\OS2 directory.

—Arnie Johnson, IBM Corporation, Austin, Texas

Product/Component	Release	CSD Level	PTF Number	Change Date	Comments
OS/2 Standard Edition	1.3	XR05150	XR05150	2-10-93	
OS/2 Extended Edition	1.3	WR05200	WR05200	5-12-93	WR05200 replaces WR05050, which can no longer be ordered on diskette.
OS/2	2.0	XR06100	XR06100	9-1-93	XR06100 replaces XR06055.
OS/2 2.10 ServicePak	2.1	XR06200	XR06200	3-1-94	This package is not for OS/2 2.1 for Windows.
OS/2 2.11 for Windows ServicePak	2.11	XR06300	XR06300	5-24-94	
OS/2 Toolkit	2.0	XR06110	XR06110	9-1-93	
	1.3	XR05053	XR05053	3-23-92	
OS/2 LAN Server/Requester ServicePak	2.0	IP06030	IP06030	4-25-93	
OS/2 LAN Server/Requester ServicePak	3.0	IP07045	IP07045	4-28-94	Includes IP07001, IP07003 (DLR), and I07005. This package has a co-requisite for WR07045 NTS/2 ServicePak, which ships with it. If you already have a refresh level of 3.00.1, you don't need this package.
OS/2 Extended Services Database Manager ServicePak	1.0	WR06035	WR06035	11-18-93	Supersedes WR06001, WR06002, WR06003, WR06004, WR06014, and WR06015.
Database Manager DB2/2	1.0	WR07015	WR07015	1-19-94	Supersedes WR07010 and WR07012. Download from one of the BBSs.
DDCS/2	2.0	WR07016	WR07016	1-19-94	
DBM DB2/2 Query Manager SelectPak	1.00	WR07022	WR07027	7-6-94	
DBM DB2/2 V1 PC DOS REQ SelectPak	1.00	WR07023	WR07023	5-6-94	
DBM DDCS/2 V2 SelectPak	1.00	WR07024	WR07024	5-6-94	
DBM DB2/2 V1 and DBAT SelectPak	1.00	WR07025	WR07026	7-6-94	
Extended Services Comm Mgr ServicePak	1.0	WR06025	WR06025	11-29-93	
System Performance Monitor (SPM/2) ServicePak	2.0	WR06075	WR06075	12/10/93	
LAN Distance ServicePak	1.1	IP07050	IP07050	10/18/94	

Figure 1. Maintenance Release Levels (continued on next page)

Product/Component	Release	CSD Level	PTF Number	Change Date	Comments
OS/2 Network Transport Services/2 SelectPak	2.00	WR07045	WR07045	4-27-94	
OS/2 LAN Adapter and Protocol Support SelectPak	2.20.2	WR07045	WR07045	4-27-94	
Communications Manager/2 Version 1.01 ServicePak	1.01	WR06050	WR06050	6-11-93	Available only on diskette.
CM/2 Version 1.11 ServicePak	1.11	WR06150	WR06150	5-31-94	
DOS	4.0, 4.01	UR35284	UR35284	9-26-91	
	5.0	UR37387	UR37387	9-22-92	
C Set/2 Compiler	1.0	CS00050	XR06150	6-29-93	
C Set C++ Compiler	2.0/2.01	CTC0002	XR06102	12-15-93	
C Set C++ Compiler	2.0/2.01	CTC0010	XR06190	9-15-94	
C Set C++ Utilities	2.01	CTM0006	XR06196	9-15-94	
C Set C++ Utilities	2.00	CTL0007	XR06197	9-15-94	
TCP/IP for OS/2 Base and Application Kit	2.0	UN64092	UN64092	8-24-94	
TCP/IP for OS/2 DOS Box Kit	2.0	UN57546	UN57546	8-24-94	
TCP/IP for OS/2 Extended Networking	2.0	UN60005	UN60005	6-21-94	
TCP/IP for OS/2 Programmer's Toolkit	2.0	UN57887	UN57887	6-21-94	
TCP/IP for OS/2 Domain Name Server	2.0	UN60004	UN60004	8-24-94	
TCP/IP for OS/2 Network File System	2.0	UN57064	UN57064	6-21-94	
TCP/IP for OS/2 X-Windows Server	2.0	UN60006	UN60006	8-24-94	
TCP/IP for OS/2 X-Windows Client	2.0	UN59347	UN59347	8-24-94	

Figure 1. Maintenance Release Levels

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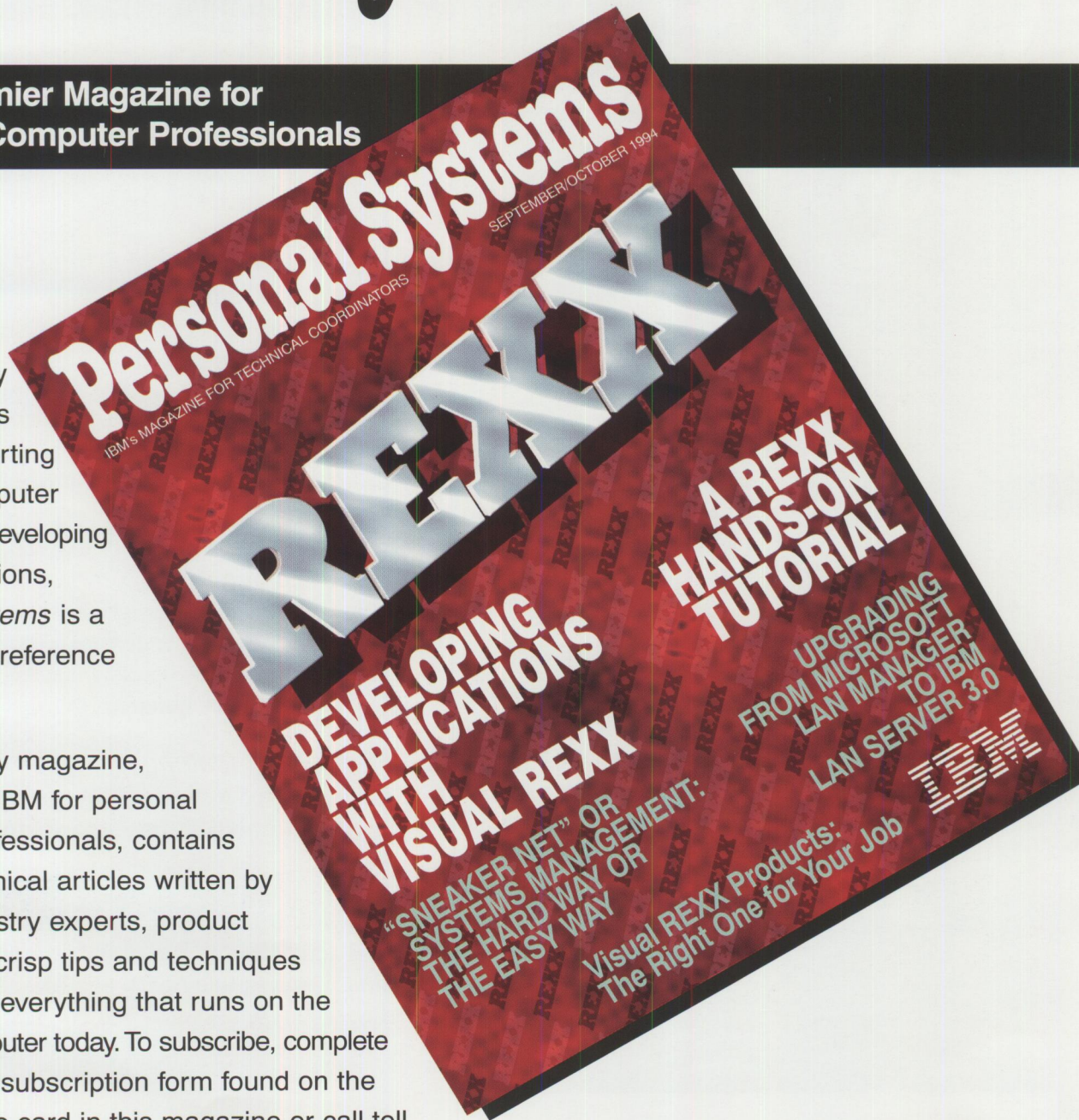
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